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## An International Magazine
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Volume XXXIII
July to December, 1921

PUBLISHED BY
THE SURGICAL PUBLISHING COMPANY OF CHICAGO
30 NORTH MICHIGAN AVENUE, CHICAGO
1921

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SCIENCE AND MEDICINE DIVISION

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XXXIII JULY, 1921 NUMBER 1

# HABITUAL OR RECURRENT DISLOCATION OF THE SHOULDER[1]

BY M. S. HENDERSON, M.D., F.A.C.S., ROCHESTER, MINNESOTA
Chief of Section on Orthopedic Surgery, Mayo Clinic

THE literature on the subject of habitual dislocation of the shoulder is characterized by the absence of definite reports on end-results. This communication is primarily a report of nineteen patients operated on in the section on orthopedics of the Mayo Clinic for recurrent dislocation of the shoulder. Twenty-six patients have been observed, twenty-three before January 1, 1920.

That dislocation of the shoulder is not more common demonstrates how wonderful are mechanism and muscle balance that prevent such an occurrence; this is all the more remarkable when one considers the poor bony formation of the joint from the view-point of mechanics.

Almost invariably there is a severe injury at the time of the primary dislocation followed by a normal convalescence, but the second and subsequent dislocations usually are not accompanied by any trauma or severe muscle strain. There is no way of finding out what percentage of persons who have had dislocations of the shoulder become sufferers from habitual dislocations. If there is any way of preventing recurrence of the dislocations the means should be known and used. Following the primary dislocation the arm should be held to the side for 3 weeks and no abduction permitted for at least 5 weeks. Some stiffness may result, but this can be overcome by massage and use, or if necessary, by manipulation under an anæsthetic.

The movements producing habitual dislocations are abduction and a slightly forward motion, the arm being in the position assumed when a person reaches for something on a shelf slightly above the level of the shoulder. I am convinced that some altered muscle tension has to do with the production of the dislocation. This lack of muscle tone may be caused by an alteration in the relationship of a muscle to its original insertion; for example, it has been claimed by many that the relationship of the supraspinatus and the infraspinatus to their insertion is altered by their being partially torn off at the time of the original injury. It may then be assumed that at least a part of their supporting action is lost because of a lengthening of their tendinous insertion. Lovett has drawn attention to the fact that he has noted an abnormally large space between the head of the humerus and the acromion process and that the shoulder is apparently lower, and he has inferred from this that the shoulder capsule was relaxed. In only two cases, one a patient with a posterior dislocation and the other an epileptic, have I been able to produce a dislocation when the patient was on the operating table anæsthetized and thoroughly relaxed. It is probable that in others by vigorous manipulation I might have thrown the shoulder out, but it must be remembered that recurring dislocations are not produced by violent trauma. My efforts, however, were quite

[1] Presented before the Western Surgical Association, Los Angeles, California, December, 1920.

Fig. 1. Anterior view of shoulder joint with bones, and attachment of muscles concerned in the dislocation.

sufficient to convince me that the dislocations seldom are due to any primary fault in the structure of the head or the glenoid fossa, but that they are produced by the action of certain muscles whereby the head of the bone is thrust against a weakened portion of the capsule. No doubt structural changes are found in persons who have had a great many dislocations, as in epileptics, but I believe the changes in such instances are the result and not the cause of the dislocations. In a previous paper on this subject I have more fully considered the anatomical structures of the shoulder-joint (7). Thomas, Rivière, Clairmont, Eden, Finsterer, Joseph, Ricard, Gerster, Young, Burrell and Lovett, and others have written excellent articles on habitual or recurrent dislocation of the shoulder.

The factors essential to the easy recurrence of a dislocation I believe, are these: The primary dislocation causes a tear in the anterior inferior portion of the capsule, which is the weakest and most lax region. This area is not supported by the tendinous insertion of muscles since the subscapularis is above and the new fibers of the triceps that have their origin from the glenoid margin are below. The supraspinatus and infraspinatus tendons may be torn at the first luxation and as true tendon is always replaced by scar tissue the repaired tendons may stretch. The insertion of these muscles may actually be torn off, resulting in relaxation and loss of tone of the muscles which permit the head of the bone to drop a trifle lower than its normal position. In not a few cases of fresh dislocations which I have seen the greater tuberosity was torn off. When the arm is in the position in which most of the dislocations occur, namely, abduction above the level of the glenoid fossa and slightly forward, the condition of the muscles and the direction of their pull are as follows:

The supraspinatus and infraspinatus have not their normal tension and thus allow the head of the bone to be a little lower than normal. The teres major, the latissimus dorsi, and the pectoralis major tend to pull the head into the glenoid fossa, but they also tend to pull the head downward and forward. The supporting action of the subscapularis is

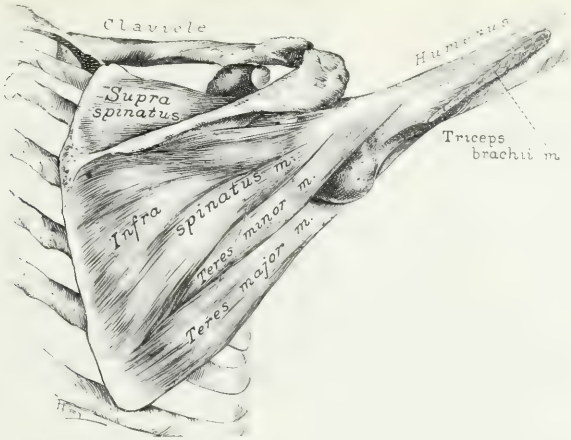


Fig. 2. Positions of muscles on posterior surface of scapula. Capsule of joints is not shown.

gone because the slightly abnormal low position of the head of the bone puts the muscle across the upper half of the head of the bone leaving the lower half unsupported. The head is thus thrust against the weak place in the capsule below the subscapularis and as the powerful latissimus dorsi, teres major, and pectoralis major contract, the head slips over the edge of the glenoid margin, bulges out the capsule, and glides up, usually to form a subcoracoid dislocation (Figs. 1 and 2).

In the group of 23 cases the average age of the patient was 28 years; 20 were males and 3 were females. The dislocations were equally divided on the right and left sides. Trauma was mentioned as the initial cause in all. Two patients were epileptics. Nineteen patients were operated on; three of the operations, however, are too recent to be of great value in estimating results. In the 16 cases, however, we may reasonably discuss the results attained by surgery.

Capsulorrhaphy was the type of operation used to prevent the dislocations (Fig. 3). The weak point in the capsule is the anterior inferior portion, and this must be strengthened. The manner of approach is immaterial. We have used an incision along the axillary anterior border, carefully avoiding, on deeper dissection, the circumflex vessels and nerves. Besides the capsulorrhaphy in a certain number of cases we have lengthened the pectoralis major, a procedure that has been advocated by Young, because we believed that this muscle had something to do in the production of the luxation.

I have classified as cures only those cases in which there have been no recurrences. One group is in reality worthy of being classified as decidedly improved and another as improved, since fewer dislocations occurred than before operation and the patients are well satisfied. Some operations are clearly failures; the condition is as bad and perhaps worse than before operation. In some instances this is undoubtedly due to faulty operative technique as occasionally the approach to the capsule of the joint is difficult, and the field discolored with blood, particularly in muscular persons.

From the group of 8 cases which I reported in 1917 (7), 2 patients (Cases 3 and 4) report that they have had dislocations, the former 6 years and 11 months after operation, and the latter 5 years and 8 months after. They are both, however, decidedly better than they

Fig. 3. Capsulorrhaphy overlapping with four doubled chromic catgut sutures. The principle of the Mayo repair of abdominal hernia is followed in this operation.

were before operation. These cases illustrate the difficulty of determining whether or not a patient is to remain free of his luxations.

In Table I the percentages of cures, and the percentages of improvement in the 16 cases, are tabulated, showing on the whole very satisfactory results. It is quite probable that our cures in this series will in time be reduced for all cases operated on one year or more have been included. Table II shows the percentages in cases in which operations have been done more than 3 years (Tables I and II).

TABLE I.—HABITUAL DISLOCATION OF THE SHOULDER

| | | Per cent |
|---|---|---|
| Patients observed | 25 | |
| Patients operated on | 19 | |
| Patients operated on previous to January 1, 1920 | 16 | |
| Patients concerning whom information has been received | 16 | |
| Patients cured | 8 | 50 |
| Patients decidedly improved | 5 | 31.25 |
| Patients cured and decidedly improved.. | 13 | 81.25 |
| Patients on whom operation failed..... | 3 | 18.75 |

TABLE II.—PATIENTS OPERATED ON MORE THAN THREE YEARS

| | | |
|---|---|---|
| Patients cured..... | 3 | 37.5 |
| Patients decidedly improved | 4 | 50 |
| Patients cured and decidedly improved.. | 7 | 87.5 |
| Patients on whom operation failed | 1 | 12.5 |

Two patients had one dislocation 6 years, 11 months, and 5 years, 8 months, respectively, after operation.

REPORT OF CASES

CASE 1 (66183). Mr. W. C., a laborer, age 24, came to the Clinic for examination April, 1917. Six years previously he had dislocated his shoulder, and the dislocation had not been reduced for 36 hours. After that there had been multiple dislocations, not prevented by apparatus. Capsulorrhaphy was performed April, 1912, and there were no dislocations until November, 1913. January, 1914, the Young operation was performed. The man has since had dislocations, and the case must be called a failure.

CASE 2 (87419). Mr. H. W., a laborer, age 25, came for examination July, 1913. Five years before his left shoulder had been dislocated in a runaway accident. Later he had had seven dislocations and was incapacitated for a month after each. There had been an interval of 2 years between the last two dislocations, the latest one occurring in June, 1913. Capsulorrhaphy was performed July, 1913, and in a communication from the patient, August, 1917, he stated that he had had no further trouble and was doing everything he wished to do with his arm. In a letter, October, 1920, he states that the arm is normal. This patient evidently is cured.

CASE 3 (90312). Mr. L. L., a clerk, age 19, was first examined at the Clinic, August, 1913. Eighteen months previously the shoulder had been dislocated while he was playing hockey. During the 18 months

the dislocation occurred probably a dozen times, the last time while he was swimming. Capsulorrhaphy was performed August, 1913. The patient's mother in a communication, September, 1917, stated that the arm felt somewhat weak, but that no dislocations had occurred. In July, 1920, 6 years and 11 months after operation, the patient dove, with his arms in the usual position. The shoulder dislocated on striking the water. This is the only dislocation since the operation. We may safely class this patient as decidedly improved.

Case 4 (107485). Mr. M. G., a merchant, age 41, was examined June, 1914. Nineteen years before he had fallen and dislocated his right shoulder. It was reduced immediately. There were several dislocations during the next 4 years, and then he "caught a cold which seemed to settle in the right shoulder." For 4 months soreness prevented his lifting the arm to the head. After that he had numerous dislocations. Ten years before the examination he fell, and in catching himself, dislocated the left shoulder. The left shoulder, however, had not been dislocated for the last 2 years and we consider the dislocation merely the result of an ordinary trauma. The right shoulder was out of joint repeatedly, the last dislocation being 3 weeks before the examination. Capsulorrhaphy was performed June, 1914. In a communication, August, 1917, the patient asserted that he had had no further trouble and that he was getting along nicely. In February, 1920, 5 years and 8 months after operation, the patient dislocated his right shoulder, although he was not exerting it unusually. There have been no further dislocations up to October 8, 1920. This patient may be classed as being decidedly improved.

Case 5 (118613). Mr. R. V. A., a bookkeeper, age 33, was examined November, 1914. After a dislocation of the left shoulder 7 years previously he had had recurring dislocations, at least 12 a year. He sometimes threw the shoulder out of joint in reaching for something on a shelf. November, 1914, capsulorrhaphy was performed. The patient was not troubled until May, 1915, when he had a peculiar feeling that his shoulder was going to slip out of joint. In September, 1917, he reported that during the last year the shoulder had slipped out twice. The patient last reported September 20, 1920; he states that he considers himself greatly improved as he has had only three or four dislocations up to April, 1920, and none since that date, and he feels that the shoulder is getting stronger. I record his condition as decidedly benefited by the operation.

Case 6 (123803). Mr. S. F. L., a lawyer, age 25, was examined February, 1915. Eight years before he had dislocated his shoulder while playing football. It was dislocated the next time while he was swimming, the third time while he was playing baseball, and since it had even slipped out while he was sleeping. At the time of the examination, he was wearing a band around the body to hold the arm to his side. He had worn it steadily for a year and a half, thus averting dislocations. Capsulorrhaphy was performed February, 1915. The patient wrote from an officers' training camp, August, 1917, that he had been able to do his bit in such strenuous tests as digging trenches, bayonet exercises, and trench storming, without suffering the slightest inconvenience or trouble from the shoulder. A letter dated October 16, 1920, records that he has had no further trouble. He is classed as cured.

Case 7 (156847). Mr. J. C. S., a merchant, age 30, was examined April, 1916. Ten years before he had dislocated his shoulder. The dislocation remained for 2 days, and then reduced itself, which suggests that it was a subglenoid dislocation. The shoulder was later dislocated many times and the patient had to take gas, ether, or chloroform about ten times for reduction. In April, 1916, the Young operation was performed. In a letter dated August, 1917, the patient declared he had had no further trouble and that this shoulder seemed to be as strong as the other. His last communication was written April 8, 1920; he stated that during sleep 2½ years after the operation he had had a dislocation which required an anæsthetic for reduction. This patient cannot be classed as cured, but he is decidedly improved.

Case 8 (200995). Miss H. J., a nurse, age 33, was examined July, 1917. Thanksgiving day, 1915, she fell and dislocated her shoulder. It was reduced about an hour later, and was held to the side for 10 days. The next dislocation occurred Christmas day, 1916, and four dislocations later. Capsulorrhaphy was performed, July, 1917. The patient states that up to the time of writing, October, 1920, she has had no recurrence. She is classed as cured.

Case 9 (233633). Mr. C. O. M., a teacher, age 46, came to the Clinic for an examination June 4, 1918. Fourteen years before he fell on the left shoulder and dislocated it. He thought he had had at least thirty dislocations, three in the last 9 months. A pull on the shoulder reduced the dislocation so that it was not necessary to call medical aid. Operation, June 11, 1918, consisted of capsulorrhaphy and lengthening the tendon of the pectoralis major. A little more than a year after the operation dislocation occurred twice in one month. The patient wrote October 8, 1920, that the shoulder has been out of joint many times and that he is coming back for observation and advice. This operation evidently was a frank failure.

Case 10 (236286). Mr. E. B., age 20, who was examined June 24, 1918, is subject to epilepsy; the attacks occur about once a month. For 6 years he was in a hospital for the insane. During an epileptic seizure, six months previous to our examination, he fell against a radiator and dislocated the right shoulder. Later it dislocated during seizures or some trivial act such as throwing a stone or sneezing. June 29, 1918, a capsulorrhahpy was performed. Three months after the operation the right shoulder was again dislocated. A letter written September 18, 1920, by the superintendent of the State School

for the Feeble Minded, where the man is an inmate, states that now both shoulders dislocate during the epileptic attacks. The operation in this case must be classed as a failure.

Case 11 (196886). Mr. E. P. H., a billiard room marker, age 37, was examined July 1, 1918. Ten years before he had been in a railroad wreck and the left shoulder had been dislocated. He reduced it himself by taking hold of a board and pulling hard. The shoulder reduced with a snap. The patient stated that he had had about eight dislocations in all. He insisted that the dislocation was always backward and posteriorly. July 6, 1918, when the patient was prepared for operation and thoroughly relaxed under the anæsthetic, I dislocated the shoulder posteriorly. Accordingly a posterior incision was made through the supraspinatus muscle, the capsule was opened and overlapped, as was also the muscle. A report from the patient, April 2, 1920, states that he has had no more dislocations but that he has an insecure feeling. Up to date he may be called cured.

Case 12 (243697). Miss M. C., age 19, was examined August 27, 1918. Four years before the right shoulder had been dislocated; 1 year later it was dislocated during a basket ball game, and the same accident occurred once a year for 2 years, and then quite often. Capsulorrhaphy was performed September 13, 1918. The patient had had no further dislocations when last heard from in April, 1920, and may therefore be classed as cured.

Case 13 (246611). Mr. G. W. G., age 41, a contractor, was examined September 24, 1918. The patient came for consultation primarily because of recurring, double, direct, inguinal hernias. The record, unfortunately, merely states that the patient had recurrent dislocations of the left shoulder for which a capsulorrhaphy was performed October 24, 1918. In a recent letter dated October 16, 1920 the patient reported that he has had no further dislocations. He may be classed as cured.

Case 14 (246884). Mr. G. M., age 23, a farmer, examined September 26, 1918, had dislocated his right shoulder 2 years before. Six months later luxation occurred again, and during the last year it had occurred seven or eight times. October 10, 1918, a capsulorrhaphy was performed on the right shoulder. In a letter written during April, 1920, he states that he had a severe fall 11 months after the operation which dislocated the shoulder, but he believed that the fall was sufficient to cause a normal shoulder to be dislocated. He may therefore be classed as decidedly improved.

Case 15 (289163). Mr. W. L., age 35, who was examined September 13, 1919, had had epilepsy since he was 15, but came to the Clinic for the purpose of having the right shoulder fixed, if possible, so that it would not dislocate so easily. Four years before the examination the first luxation had occurred and there had been about fifteen since. Capsulorrhaphy was performed September 22, 1919. A letter received in October, 1920, states that there has been no dislocation. Although the time is short this patient may thus far be called cured.

Case 16 (274650). Mr. F. F., age 29, was examined December 12, 1919, because of a dislocating right shoulder. The first dislocation was sustained during a wrestling bout; six or seven had occurred since, in one instance when he was swimming and in one when he sneezed. December 16, 1919, the usual capsulorrhaphy was performed, except that an attempt was made to include more tissue in the overlapping, and two strands of silk were used. The operation was made more difficult than usual by the greater amount of hæmorrhage, and the patient was quite muscular so that exposure was difficult. A numbness of the right hand followed the operation; this gradually improved. February 4, 1920, a neurologic examination by Dr. Sheldon and Dr. Woltmann showed an irregular distribution of sensation and they believed that the condition was merely a traumatic neuritis of the brachial plexus and that no nerve or nerves could be singled out as being involved. This is the only case in our series in which trauma was inflicted on the nerves and the only explanation I can offer is that in some way our efforts in retracting to obtain exposure were too vigorous. A letter from the patient during September, 1920, states that he has had no trouble with the shoulder except a feeling of weakness, but his hand is still numb in the little and ring fingers, and the power in these fingers is weak. Evidently the ulnar nerve is involved. It may be said for the present that he is cured.

Case 17 (309320). Mr. M. R., age 22, was examined March 17, 1920. Three years before in jumping over a fence and holding the arms abducted, as one does in jumping over an obstacle, the right shoulder dislocated. The dislocation occurred twice afterward, the last when he jumped from a bobsled 2 weeks before our examination. This case is of interest, since in so far as we could learn, there had been no primary severe trauma such as had occurred in the other cases. March 23, 1920, capsulorrhaphy was performed and the pectoralis major was lengthened. The case is too recent to include in reporting results.

Case 18 (320106). Mr. E. H. N., age 22, examined June 16, 1920, while playing football in September, 1914, had dislocated his left shoulder. One month later while again playing football the joint luxated. Following this the patient had seven dislocations, one while swimming, and one while in bed after a 15 months' interval. June 18, 1920, a capsulorrhaphy was performed; the sheaths of the teres major and of the pectoralis major were lengthened. The operation is too recent from which to judge ultimate results.

Case 19 (326010). Mr. G. C. P., age 36, was examined February 22, 1920. This patient had had epilepsy for 8 years but the first dislocation of the left shoulder occurred 5 months before our examination. A second dislocation had occurred 6 weeks before during a seizure. Unfortunately the doctor

in reducing it broke the surgical neck of the humerus. An open operation was performed and good position was secured, but during an epileptic attack (these attacks usually came on during sleep) the shoulder luxated. When we saw him the position of the fracture was so poor and the dislocation had been present so long that my colleague, Dr. Meyerding, excised the head. We have not heard from the patient since his dismissal August 24, 1920, but at that time function promised to be good.

## CONCLUSIONS

1. Capsulorrhaphy to strengthen the shoulder gave 50 per cent cures in the 16 cases of habitual or recurrent dislocation of the shoulder. Five of the patients (31.25 per cent) are so decidedly improved that they are more than satisfied with the operation. This percentage of improvement and the percentages of cures give good results in 81.25 per cent.

2. It is probable that muscle pull or possible relaxation of the shoulder capsule above has not been sufficiently considered in the treatment. It is reasonable to suggest, therefore, that the pectoralis major, teres major, and latissimus dorsi be lengthened, and, if thought necessary, the region of the capsule where the supraspinatus and infraspinatus are inserted and the anterior inferior portion of the capsule be reefed.

I wish to thank Dr. H. T. Jones, assistant in the section on orthopedic surgery of the Mayo Clinic, for his assistance in looking up the literature and in tracing the patients.

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# ARTHROPLASTY OF THE JAW

## With Some General Remarks on Focal Infection and on the Formation of New Joints[1]

By JAMES M. NEFF, M.D., F.A.C.S., Chicago

THE case which is reported below is rather unique in the following particulars:

First, the ankylosis had been present for 7 years, developing during an attack of uræmic coma in the later months of pregnancy. At that time the patient had suppuration in the mouth, presumably around some of the teeth, but she does not know which side was affected, or whether the trouble was on both sides. All that she could remember was that there was "pus" coming from the mouth at the time and when she recovered from the coma, the jaw was firmly fixed with the teeth of the maxilla and mandible in close apposition. Since that time she has been unable to open her mouth. Some of the teeth on the left side were extracted so that she could take soft and liquid food, upon which she has subsisted ever since.

Second, the age of the patient. She is now 39 years old, so the ankylosis developed when she was between her thirty-second and thirty-third year.

Third, the presence of a persistent and continuous nephritis from the time the trouble started, with much albumin in the urine, epithelial, granular, and hyaline casts and many leucocytes. The systolic blood pressure at the time I first saw her was 165 to 170 mm. with 95 to 100 diastolic.

Fourth, the presence, in association with the nephritis, of a marked infection around the roots of nearly all of the teeth. The abscesses around some of the teeth, as shown in the roentgenograms (Figs. 1 and 2) were very large and some of the teeth were so loose that they could be picked out with the fingers. She had had no dental work done at any time since the onset of the trouble.

Fifth, the diminution of albumin and the lowering of the blood pressure following the removal, at time of operation, of the abscessed teeth and the drainage of the pus pockets, so that only a trace of albumin was present, with an occasional pus cell and hyaline cast and the blood pressure remained down.

Sixth, the roentgenograms of the temporomandibular joint (Figs. 1 and 2), made by Dr. Hollis Potter, showed the left joint normal, but the articular surface of the condyle on the right side was irregular and the space obscure though one could not say whether or no there was a fibrous ankylosis within the joint.

Seventh, the chin was retracted to a noticeable degree with the result that the lower incisor teeth were posterior to the upper to an abnormal extent—a rather unusual finding in cases developing so late in life.

Eighth, the impossibility of determining by the most careful examination of the patient which side the fixation was on or whether it involved both sides. Examination of the inside of both cheeks showed the masseter muscles very tense and the anterior edges sharp and firm. It was quite certain that the fixation was extra-articular, but nothing more could be said before operation.

These are the main points of interest in the case herein reported, except the operation and findings, which will be related later.

Examination of the patient showed that she was fairly well nourished, with heart, lungs, and abdomen, negative. The condition of the teeth in general has been described above. The lower jaw could be moved downward to the extent of about $\frac{1}{8}$ inch, as measured by the incisor teeth. There was also about the same degree of lateral motion. The X-ray findings and the condition of the jaw are described above. It was absolutely impossible to say which side was involved or whether it was on both.

Operation, January 31, 1921, at the Michael Reese Hospital. Gas anæsthesia throughout. A semicircular incision was made over the right zygomatic process, convexity upward, through the skin and subcutaneous fat, and this flap was turned downward. The zygomatic process was now exposed by an incision through the temporal fascia, well posterior and in a direction forward and upward. This

[illegible]

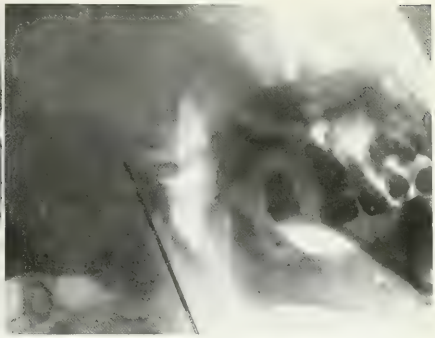


Fig. 1 (at left). Roentgenogram of the left temporomandibular joint, showing clear space, *a*, between the condyle and mandibular fossa.

Fig. 2. Roentgenogram of the right temporomandibular joint. The space, *a*, between the condyle and the mandibular fossa is not clear nor well defined. Note also the alveolar process of the maxilla. The teeth are loose and show abscesses around the roots.

incision is most important to avoid the temporal branches of the facial nerve. The soft tissues were retracted forward and slightly downward, after separating them from the zygoma with a periosteotome. One-half inch of the zygoma was resected by means of a gigli saw, but was not preserved for transplantation. The temporomandibular joint was now carefully exposed and found to be normal, so far as the interior of the joint was concerned. The coronoid process was next exposed and it, with the insertion of the temporal muscle, was resected. No movement of the jaw followed. The tense portion of the masseter muscle was divided anteriorly with no result. As is usually necessary in extra-articular fixations, the neck and condyle were resected at a point one-fourth inch below the base of the condyle. Even now there was absolutely no motion in the jaw. The bleeding was controlled and the same incision and exposure were made on the left side. One-half inch of the zygoma was resected and the left temporomandibular joint was found to be normal. The left coronoid process with insertion of the temporal muscle was resected without the slightest effect as regards motion. The tense portion of the left masseter muscle was divided without result. There remained but one thing to do and that was to resect the left condyle with ¼ inch of the neck. This was done, and at once the jaw opened to the extent of 1 inch, as measured by the distance between the upper and lower incisor teeth. No muscle, fascia, nor any other substance was interposed between the mandibular fossa above and the neck of the condyloid process below. The bleeding on both sides, which was not profuse, was permanently controlled by ligature and the skin flaps brought up and approximated with horse-hair sutures. A small rubber drain was placed in each wound at the posterior angle and allowed to remain for 24 hours. Forty-eight hours after operation the face was enormously swollen, but this had completely subsided on the fifth day. The wound healed by primary union and the patient was sitting up on the sixth day.

The rapid and steady improvement in the urinary findings and blood pressure has been noted above. After the swelling had subsided, passive movements of the mandible were painless and normal in degree. As regards the active motion, she could open the mouth to the extent noted above but could not completely close it, that is, the upper and lower alveolar processes could not be brought into complete approximation and the lower process was 3/16 inch posterior to the upper. However, this retraction was present before operation. The ability to close the mouth has steadily improved since operation.

In regard to the temporal branches of the facial nerve, 2 weeks after operation, when the patient

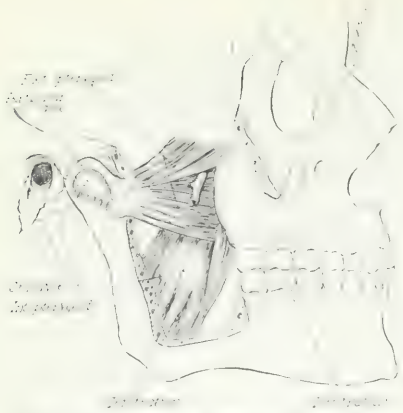

Fig. 3.—The pterygoidei externus and internus. The light area at the internus shows where a fibrous infiltration might take place and act as a fulcrum, extending from above to the angle of the mandible. This same fulcrum action would be possible if fibrous tissue extended from maxilla to mandible, as shown in the dotted area. The action of the muscles is explained in the text. (Redrawn from Gray's *Anatomy.*)

Fig. 4.—Showing the complicated structure and intricate function of the temporomandibular joint. (Redrawn from Gray's *Anatomy.*)

left the hospital, there was partial loss of function of the frontalis muscle on both sides and of the corrugator and orbicularis on the right side. This was associated with frequent twitchings of the orbicularis on the right. These twitchings, together with the fact that every effort as regards the incision, exposure, and retraction of the soft parts was made at the time of operation to avoid the nerve, lead me to believe that the interference with the function of the nerve was temporary and due to traction, rather than division of the branches. The last report received from the patient, 6 weeks after operation, states that the motion of the mandible has improved a great deal and the function of the facial nerve is again quite normal (Figs. 9 and 10).

I have described the operation in this case in detail, because the mechanism of fixation and the pathology seem to me rather unique. It was not until the resection of the coronoid processes, with the insertion of the temporal muscles, the division of the tense portion of the masseters and the resection of both condyles, with one-fourth inch of the necks, had been performed, that the mandible could be moved the slightest fraction of an inch more than before operation. It was just as firmly fixed up to the last step of the operation (the resection of the left condyle), as it was before the operation was commenced. This leads me to believe that the fixation was due to infiltration and scar tissue formation in the soft tissues of both cheeks, near the mucous membrane, probably about the middle of the mandible, laterally, or in the internal pterygoid muscles (Fig. 3), where the mechanical effect would be the same. I say this because I divided both temporals and the tense portion of both masseters, as well as resected one condyle, without result. When the other condyle was resected, the mouth opened, due to the fact that the last portion of the posterior end of the double lever, the condyloid process, had been removed, thus allowing the anterior end of the lever, the chin, to drop down. In this case, of course, the fulcrum was in the middle of both sides of the lever (the mandible), or at the angles (the insertion of the internal pterygoids), and consisted of scar tissue, attached above to the sides of the maxilla and below to the sides of the mandible, at about their centers, or at the angles, where the internal pterygoids insert. This seems to me to be the only logical explanation of this particular case and probably applies to extra-articular ankyloses, where both condyles must be resected to secure motion. So much for the case herein reported.

## ANATOMY

To understand the pathology and mechanics of the different forms of ankylosis of

the jaw, it would seem advisable to review briefly the anatomy of the temperomandibular articulation. The joint is of the ginglymo-arthrodial type (1), that is, the motion in it is a combination of the hinge and gliding movement, the former predominating. The movements permitted are extensive: the mandible may be depressed or elevated, carried forward and backward, and there is a slight side to side motion. There are two distinct joints in the articulation; one between the disk and the mandibular fossa, and the other between the articular disk and the condyle (Fig. 4). When the mouth is opened widely both joints come into play, the hinge action taking place in the lower, the gliding in the upper, where the disk glides forward on to the articular tubercle. In closing the mouth, the reverse action takes place. When the jaw is protruded forward the action takes place in the upper joint (gliding motion). In the act of chewing, the condyles glide alternately forward and backward, one remaining in place and rotating vertically on its disk.

The different movements of the mandible are produced by the following muscles (Figs. 3 and 5): It is elevated by the masseter, the internal pterygoid and the anterior part of the temporal muscle. It is depressed by its own weight, and the platysma, digastricus, mylohyoideus and the geniohyoideus muscles. It is drawn forward by the pterygoidei, internus and externus (Fig. 3), the superficial portion of the masseter and the anterior fibers of the temporalis. Chewing is produced by the alternate action of the pterygoidei on each side (see Fig. 3). The anatomy of the bones and ligaments is sufficiently clear from the cuts taken from Gray's *Anatomy*. The reason for going into the anatomy and physiology so in detail is to show how complicated is the structure and action of these joints and how they work together, simultaneously in an intricate manner, in the apparently simple act of mastication. From these facts there is but one conclusion to be drawn and that is that in every case of ankylosis operated on, whether it be articular, extra-articular, or articular-extra-articular, the result must fall very far short of the normal function, much

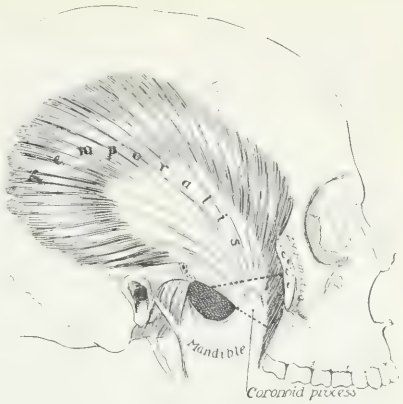


Fig. 5. The temporalis showing its origin and insertion into the coronoid process. The dotted lines show where the coronoid process may be resected with the insertion of the muscle. The action of the muscle is explained in the text. (Redrawn from Gray's *Anatomy*.)

more so, than, for example, in the elbow. In other words, the very best result, in the hands of the most skillful operators, must of necessity be far from perfect, because it is impossible to make a new joint, which even approximates the normal in structure. That however, does not contra-indicate operation, as the restoration of even moderate motion in the joints is to be looked upon as an enormous improvement over ankylosis. In fact, in my opinion, there are but three joints in the body where arthroplasty is indicated and they are: the elbow, the temporomandibular, and the tarsometatarsal joint of the great toe, the last in cases of bunion. In the first two, motion is of greater importance and can be secured in a greater percentage of cases, than in any other joints in the body. The reasons for this will be explained later.

## PATHOLOGY AND PATHOLOGICAL ANATOMY OF TEMPOROMANDIBULAR ANKYLOSIS

The classification as to the location of fixation as given by Henderson and New (2) is the most logical. They report 23 cases treated in the Mayo clinic and divide them as follows: (a) articular, where the fixation is within the joint; (b) extra-articular, where it

is outside the joint; and (c) articular-extra-articular, where it is both inside and outside the joint. Fifteen of their 23 cases were articular; 5, extra-articular; and 3, articular-extra-articular.

In the majority of the articular type, the ankylosis occurred between the ages of 1 and 10 years. In the extra-articular and articular-extra-articular, it developed with equal frequency in the first three decades.

If the ankylosis is unilateral and develops early in life, before the jaws are fully formed, a typical deformity results. The chin is retracted and displaced toward the affected side, while the normal side appears flat. There is considerable elasticity to the mandible, so that even in cases of unilateral bony ankylosis, there is some movement when an attempt is made to open the mouth. This movement is necessarily on the normal side, causing the chin to move toward the affected side.

The motion is greater in cases of fibrous ankylosis and where the fixation is outside of the joint. Of course, in bilateral bony ankylosis, there is no motion at all. *In the articular types* the pathology is simple. There is:

1. Bony union of the condyle with the mandibular fossa, or, zygoma, mandibular fossa and condyle may form a continuous bony mass;

2. There may be a great deal of fibrous tissue around the joint;

3. The joint may be filled with cartilage and bone, uniting the two articular surfaces (3);

4. The bones may be united by fibro-osseous tissue; or,

5. The joint cavity may be traversed by fibrous bands, between which are small spaces, containing synovial fluid.

Of these changes, 3, 4 and 5 are usually found in the earlier and intermediate stages, because in the long standing cases, the joint cavity is completely obliterated by fibrous tissue or bone. For a detailed description of the changes taking place in the joint, see Lyons' article above referred to.

6. In all the long standing cases where there has been inflammation within the joint, the capsule is thickened and united with the tissue in the joint.

7. In the cases which develop early in life, before the jaws are fully formed, the ramus on the affected side is shortened, because the growth of the bone has been interfered with.

8. This early fixation and shortening of the ramus, causes a retraction of the chin and a deflection of the same toward the affected side.

9. In all long standing cases, the muscles of mastication are atrophied from disuse and often show fibrous changes. This is especially true in the temporal and masseter muscles. The constant attempts to open the mouth probably contribute toward the retraction of the chin.

*In the extra-articular cases* due to infections and abscesses from the teeth or in the cheeks, there is scar tissue formation in and around the muscles and around the joint itself. This fibrous tissue may stretch from the maxilla to the mandible, firmly fixing the jaw as was probably so in the case here reported. In old cases, particularly, the teeth are always in very bad condition, because, on account of the fixation of the jaw, no dental work can be done. By "bad condition" I mean there is frequently pyorrhœa, caries and abscesses at the roots, in the alveolar processes.

ETIOLOGY

Lyons says that the sexes are about equally affected. As regards the age at which the pathological changes take place, Henderson gives the following statistics from the Mayo clinic. Among the 15 articular cases, 9 developed between 1 and 10 years, 3 between 11 and 20 years, 2 between 21 and 30 years, and 1 after 30. Of the 8 extra-articular and articular-extra-articular cases, 2 developed during each of the first three decades, one in the fourth and one in the fifth.

Traumatism and infection are responsible for the great majority of cases of ankylosis of the jaw, both of the articular and extra-articular types. The forms of traumatism of greatest importance are falls or blows on the chin, recurring dislocation of the jaw and direct injuries over the joint itself. These statements apply especially to the articular form. Vecchi [8] has observed that falls on the chin may lead to temporomandibular

ankylosis on both sides, but that when the trauma is direct, the ankylosis is unilateral. In the extra-articular and articular-extra-articular forms, infection plays by far the more important part. The infection may be direct or indirect. By *direct*, I mean it has extended from some neighboring source of infection, as from the teeth, the middle ear, an abscess in the cheek or from an osteomyelitis of one of the bones that goes to make up the joint or one in the neighborhood. By *indirect*, I mean that the infection has come through the blood stream, as during the course of any of the infectious diseases, for example, scarlet fever, measles, typhoid, gonorrhœa, etc. The infection may or may not be associated with pus formation in or around the joint. As regards focal infections playing an important part in temporomandibular arthritis, or that of any other joint in the body, I think it is greatly overestimated, *as the question now stands*. The same may be said of its rôle in neuritis, myositis and a thousand and one other conditions, where it is held responsible for the trouble; for example, appendicitis, cholecystitis, duodenal and gastric ulcers, etc.

Any one who has an open mind and is not prejudiced by what he has heard and read on the subject of focal infection, must surely see at a glance that there is in it but a grain of truth and a pound of rubbish, *in the present conception of the subject*. The personal case reported is the grain of truth, because the albuminuria, with casts and high blood pressure, which had existed for 6 years, disappeared within 2 weeks after the infected teeth had been removed, but in my own personal experience, both civil and military, I have seen the pound of rubbish, as has everyone else with similar experience. It is merely a case of every day observation on the part of the one with average intelligence and intellect and a logical mind, against one with equal intelligence and intellect, who works in a bacteriological and pathological laboratory, experimenting on animals, but who has fixed ideas on the subject of focal infection. The one who has fixed ideas and is constantly at work to prove them, has of necessity a less logical mind than the aforesaid one who carefully observes large numbers of cases.

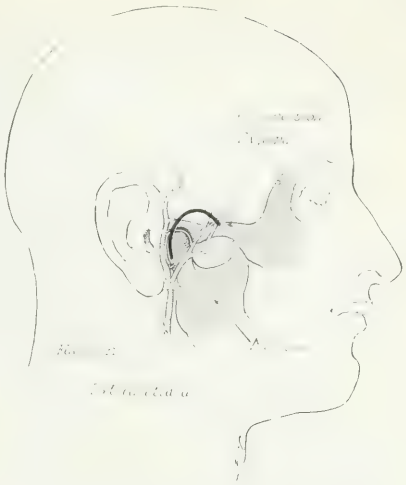

Fig. 6. Showing the curved incision through the skin and superficial fat, with its relations to the zygoma, the superficial temporal artery, and the temporal branches of the facial nerve, as they cross the zygoma.

I spent a year in active service in France with the English army during the great war and observed a very large number of cases. The English soldiers had notoriously "bad teeth"; the great majority of them had never been to a dentist, the teeth were carious, many of them had cavities and pyorrhœa was common. It is logical to assume that in such teeth, infections and even abscesses at the roots must be the rule and not the exception, but notwithstanding these facts, it would be difficult to imagine a finer group of men. They were examples of perfect physical health and fitness, and diseases, such as neuritis, myositis, arthritis, appendicitis, cholecystitis and duodenal and gastric ulcers, were extremely rare among them while in the training and reinforcement camps. After being in the trenches for prolonged periods of time, under abnormal and extremely trying conditions, they did develop neuritis, myositis, and arthritis, just as any normal individuals might, who had been taken away from healthful environ-

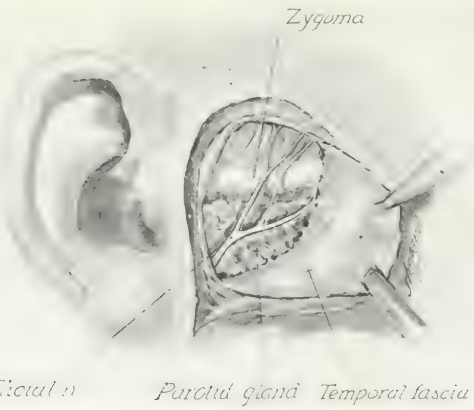


Fig. 1.—The temporal branches of the facial nerve as they cross the zygoma. The flaps of skin and temporal fascia have been dissected forward and retracted. (From a dissection.)

ments and placed under these same abnormal and trying ones. Furthermore, there was no greater proportion of cases of appendicitis, cholecystitis, and duodenal and gastric ulcers, than is observed among persons who have their teeth properly cared for. The same applied to the tonsils. Very few of the soldiers, who to all intents and purposes, were in perfect health, had had their tonsils removed, and yet it is safe to say that if a nose and throat specialist had examined them, the same proportion, as in any civil community, would have been advised to have their tonsils removed, on account of enlargement, "pus pockets," crypts, etc., or to have operations on the nose to relieve sinus infections, deflected septums or enlarged turbinates.

To my mind the focal infection theory is very greatly overdone. I have seen hundreds of persons whose teeth have been condemned by dentists, and hundreds whose tonsils have been examined by throat specialists and pronounced "diseased," because of enlargement or because "pus" could be expressed by pressure, and yet these persons have remained in good average health, having consulted the doctors or dentists, for some temporary ache or pain. Furthermore, I have seen many cases of neuritis and arthritis, who have had their teeth "treated" or extracted, or their tonsils removed, or both, and who have continued to suffer from their ailments for a very prolonged period of time after their operations. It is well to remember that medicine and surgery are not mathematical sciences, in fact, not sciences at all, and therefore fads and fancies are certain to creep into them. During the past 20 years that I have been in the surgical profession, I have seen many fads and fancies come and go, so I know whereof I speak. I believe that the time has come for a reaction against the focal infection theory, so that it may find its proper level. On the other hand, I think that all tonsils that are really diseased and causing definite trouble, should be removed and that the teeth should be kept in as nearly perfect condition as possible; this is merely logical reasoning, as applied to the individual; but to attribute every ache and pain and every abdominal disease to some focal infection; that is going too far. It might also be added that there are about 23 feet of small intestine, 5 feet of large intestine, the œsophagus, stomach, the genito urinary tract and the

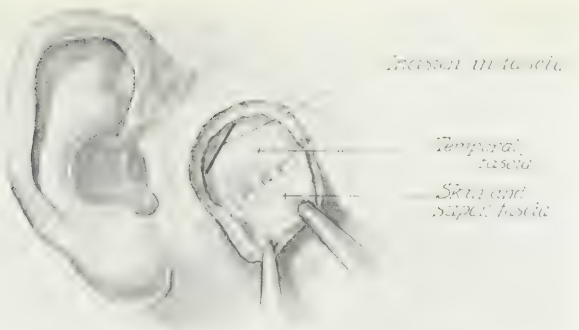


Fig. 8. The curved incision has been made through the skin and superficial fascia and the flap dissected downward and forward, exposing the temporal fascia. The black line shows the straight incision through the temporal fascia, upward and forward, over the zygoma and well posterior. This is to avoid the temporal branches of the facial nerve. (From a dissection.)

entire skin surface, which might, in some portion of their enormous extent, harbor a focal infection. Yet how seldom do we hear that a lesion of the joints, nerves, bones or abdominal organs, might be due to a focus of infection in any of these structures. Of course, the argument will be brought forth that the organisms in the tonsils and teeth are different from those found in the above mentioned lesions and are more prone to enter the blood stream and thus give rise to metastatic inflammatory processes, but again I insist that medicine, surgery and their allied branches are not mathematical sciences and absolute deductions cannot be made from laboratory or clinical studies. Also, the subject of focal infections is still an open one and by no means settled in the minds of logical thinkers, which, of course, could not be the case if it were a proved fact.

### SYMPTOMS

The symptoms are evident from the pathology, which has been described. During the inflammatory stage there is pain in the joint, especially on motion, with tenderness on pressure over it. In addition there are all the symptoms of the etiological factor, whether it be traumatism or infection, or both. When the patients come for surgical relief, which is usually several years after the development of the trouble, they are as a rule well nourished and complain of no trouble, except, inability to open the mouth and take solid food, the "bad" condition of the teeth, and there may be some digestive disturbances, such as constipation, gas formation, etc., due to the fact that the patients are obliged to live on liquid and soft food, which as a rule is concentrated and leaves no residue.

### PROGNOSIS AND GENERAL CONSIDERATIONS ON ARTHROPLASTY

The outlook in cases of arthroplasty on the jaw is good as regards motion. Of course, the motion can never be free and normal, on account of the intricate formation of the joint and its complicated movements, but the patients operated on are able to masticate food in the course of a few weeks, the facial expression is better, the speech is improved and they are able to keep the teeth in good condition.

Thomson (7) thinks that arthroplasty yields excellent results in cases where the ankylosis has been produced by traumatism, but that it is very likely to fail if the fixation has been produced by infection, because the infection, which has been encapsulated for a long time,

Fig. 9 (at left). Showing patient after operation. Mouth closed

Fig. 10. Patient after operation. Extent to which mouth can be opened.

may be "lighted up" by an operation, and there may be an increased formation of bone after the operation, causing a return of the ankylosis. I think this is true if the infection is tubercular, but not true if it is other than tubercular, and sufficient time be allowed to elapse between the acute process and the operation of arthroplasty. This period of waiting should be at least 6 months.

I consider that ankylosis of the temporomandibular and elbow joints are, *with an occasional exception*, the only two indications for arthroplasty. This brings up the very important question as to what makes for good results in arthroplasty. In my opinion the following conditions are necessary for a good result: articular surfaces of *small area*, very limited gliding motion within the joint, and the absence of great pressure within the joint. It fortunately happens that the two joints in the body where free and painless motion are most necessary, meet with these requirements, e.g., the temporomandibular joint and the elbow. It is well to remember that in all of the important joints of the body, where arthroplasty would be considered, sliding or gliding of one articular surface upon another is necessary to produce motion. It makes no difference whether the motion is of the ginglymus (hinge), trochoid (rotary), condyloid or enarthroid (ball and socket) variety, the smooth synovial surfaces slide one upon the other, during motion. Where the important motion is limited in extent, as in the jaw, fibrous union of the bones, may take the place of a joint or bursal cavity with sliding surfaces, but this is not true of the other important joints. In the elbow, knee, hip and shoulder, bursal formation must take place before extensive and painless motion can be produced. In the knee and hip we occasionally see successful arthroplasties, but the failures greatly outnumber the successes. A painless bony ankylosis of the knee in extension, is very much better than a painful arthroplastic knee, even though the motion be quite normal and extensive. The same applies to the hip, provided, of course, the ankylosis is not bilateral. Painful motion is often seen in both of these joints after arthroplasty, because, great weight must be borne in both, when walking or standing and, especially in the knee, very extensive sliding motion, which in turn means extensive bursal formation, is necessary, if there is to be any degree of useful motion. These extensive sliding surfaces are seldom produced by any method. Therefore, I consider arthroplasty usually contra-indicated in both knee and hip, and think that the production of a bony ankylosis with the limb in good position, is much to be preferred. These patients get about very well and with but little inconvenience. I have, however, seen wonderful results follow arthroplasty, in both hip and knee (4), but they are the exception and not the rule. Arthroplasty on the shoulder is contra-indicated, because the scapula will follow the humerus in all of its useful and necessary movements, provided, of course, that it is ankylosed in good position. The operation on the wrist and ankle is never indicated. For the earlier references on arthroplasty, see an article published by me in SURGERY, GYNECOLOGY AND OBSTETRICS, in 1912.

The operation for relief of ankylosis of the jaw is not new, the first attempt having been made by Esmarch in 1855. He removed a wedge-shaped section of the bone from the horizontal portion of the mandible, but it did not prove successful. In 1878 Koenig introduced the operation of resection of the mandibular head (3). The credit for modern arthroplasty, not only on the jaw, but on all

of the other joints, belongs to the late Dr. John B. Murphy, of Chicago, who did the best work in this branch of surgery that has ever been done by any surgeon, though he was preceded by others in both experimental and practical work, notably Chlumsky, Glueck and Koenig.

### TREATMENT AND DIAGNOSIS OF ANKYLOSIS OF THE JAW

All surgeons agree that forcible separation of the jaws is worse than useless, because the ankylosis, whether it be bony or fibrous, is certain to recur and the patient is put to a great deal of unnecessary suffering. The operation of resecting a part of the horizontal portion of the jaw is almost equally useless, because the bone will unite if the wound heals by primary union, or there will be a painful discharging wound if it becomes infected and union fails to take place. These points being true we are left to deal by open operation, with the condyloid process, the joint itself and the structures around it. The type of operation indicated will depend entirely upon the pathology and the form of ankylosis present. Now, it is rather difficult in certain cases, as in the one here reported, to say, before operation, just what the pathology is, and even during the operation the difficulty may persist until the very last step, as in this same case. The X-ray films in this case showed that in all probability there was no bony ankylosis, but the right articular surface was irregular and the cavity obscure. There was no other pathology except in the alveolar processes at the roots of the teeth. In the cases of bony ankylosis that occur early in life, before the jaw is fully formed, the typical deformity with shortening of the ramus, deflection of the chin toward the affected side and flattening of the cheek on the opposite side, make the diagnosis easy. In some cases the X-ray films make the diagnosis of bony fixation. If there is absolutely no motion of the jaw, bilateral bony ankylosis is present. If there is slight motion on one side, with absolute fixation on the other, there is unilateral bony ankylosis. If there is a small degree of lateral and vertical motion on both sides, the probability is that the case is one of extra-articular or articular-extra-articular fixation. In all of these cases the open operation is indicated. If an absolute diagnosis as to the condition present and side affected can be made before operation, so much the better; if not, it must be made during the operation and, whatever procedure is necessary, must be carried out at the time. In many cases it is exceedingly difficult to say which side is affected unless the typical deformity is present.

The incision necessary to expose the joint is over the zygoma, semicircular (Fig. 6) or angular, with the longer arm posterior in front of the ear; upward, if the horizontal portion is along the lower margin of the zygoma (Lyons, 3) and downward if along the upper border (Henderson, 2). The structures to be avoided must be carefully borne in mind: (a) the temporal branches of the facial nerve and (b) the internal maxillary artery, which is the larger of the two terminal branches of the external carotid artery. It arises just behind the neck of the mandible and passes forward between the ramus and the sphenomandibular ligament. It is, therefore, easily injured and causes very troublesome hæmorrhage unless precautions are taken to avoid it. This is very easily done if the operator, after exposing the temporomandibular joint from above, adheres closely to the bone in separating the soft tissues from the neck. Lyons uses a steel ribbon 1 centimeter in width around the condyloid neck to avoid injury to the artery, but this hardly seems necessary if one is careful. Injury to the superficial temporal artery is not serious, as the vessel can be readily ligated if injured. Injury to the temporal branches of the facial nerve is the most serious accident that might happen during the operation. After the facial nerve emerges from the stylomastoid foramen it runs forward and divides behind the ramus of the mandible into its branches of distribution. It is with the temporal branches that we are chiefly concerned. They cross the zygomatic process a little anterior to the external meatus, under the temporal fascia (Fig. 7) and pass to the temporal region, supplying the auricularis anterior and superior. They then join with

branches from the maxillary and mandibular to supply the frontalis, orbicularis-oculi and corrugator. The best way to avoid these nerves is to make the curved incision mentioned above (Fig. 6) beginning an inch in front of the external meatus, curved backward over the upper border of the zygoma and downward for ¾ of an inch in front of the ear. This is through the skin and superficial fat, a flap of which, is retracted downward and forward (Fig. 8). The zygoma is then exposed by another incision ¾ of an inch long through the temporal fascia well posterior and running upward and forward (Fig. 8). The temporal fascia with the temporal branches of the facial nerve are now separated from the zygoma by means of a periosteotome and retracted in a direction forward and a little downward. About ½ inch of the zygoma is now resected, after which the condyle will be seen in the posterior portion of the wound. If bony ankylosis exists, the joint surfaces should be chiseled apart and the condyle with ¼ inch of the neck removed.

The best way to divide the bone in this situation, is with a straight bone cutting forceps. The bone is not cut through with one bite, but is divided by a series of small bites, beginning at the side of the neck and going a little deeper with each successive bite. In this way no unnecessary traumatism is done and it is surprising how easily any bone may be divided in this manner. If the jaws open widely and freely after this, nothing more is necessary, except to control the hæmorrhage and close the wound, with or without 24 hour drainage.

For fibrous ankylosis within the joint the same procedure should be followed. It is not necessary to turn in a flap of muscle or fascia, as the soft tissues will come together between the bones without flap formation, and fibrous union or bursal formation take place. Many operators, however, have in the past and do now, advocate turning in a flap of the temporal muscle or fascia to prevent union of the bones or produce a bursal formation between the ends. Nearly all of Dr. J. B. Murphy's work was done after this manner. (For references on the work of J. B. Murphy in temporomandibular ankylosis, see the article by Henderson and New, 2). Vecchi (8) also reports in detail a case to illustrate the good result following a resection, with the interposition of a muscle flap. It is probable that with or without a flap, fibrous union occurs, which answers the purpose here just as well, because the important motion is limited in extent and sliding surfaces are not absolutely necessary to good, if not entirely normal, function.

If the ankylosis is extra-articular, the fixation will be found to be due to fibrous tissue formation, either within the muscles of mastication, the temporal, masseter or pterygoids, or outside them, near the mucous membrane of the mouth, which is the more common, or toward the skin surface, which is less common. Chubb (5) reports 5 cases in which removal of the coronoid process with the insertion of the temporal muscle overcame the ankylosis, and New (6) records another case of ankylosis due to fixation of the temporal muscle, following an operation for removal of the gasserian ganglion 3½ years before. He resected the coronoid process, with the insertion of the temporal muscle, and secured a good result.

Where the fibrous tissue is outside the muscles, it must be dealt with accordingly, great care being taken not to enter the buccal cavity, as in this case, infection of the wound, with its disastrous sequelæ would result. When the jaws will not open after the extra-articular bands have been divided, or where all of these bands cannot be found after opening both sides, and in practically all long standing cases, as in the one herein reported, resection of one or both condyles for ¼ or ⅜ inch of their extent, is the proper procedure. When this is done the mouth will open, whether the bands are divided or not, because of the leverage principle which has been described above.

The after-treatment consists of keeping the jaws separated, with the threaded wooden cone, two tongue depressors placed together between the front teeth and separated outside (New) or forcing the jaws apart with the index finger on the lower teeth and the thumb on the upper (Potts). These exercises must be practiced regularly and frequently for

certain periods each day and persisted in indefinitely. These passive exercises must be combined with active exercises, such as opening the mouth as widely as possible many times each day, and chewing gum. If the operation is carefully performed and the after-treatment properly carried out, good results are almost certain to follow. As I said before, arthroplasty on the jaw is one of the most satisfactory operations which is performed by the surgeon.

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# FOCAL INFECTION AND ELECTIVE LOCALIZATION OF BACTERIA IN APPENDICITIS, ULCER OF THE STOMACH, CHOLECYSTITIS, AND PANCREATITIS[1]

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INFECTIONS in organs or tissues remote from the surface of the body, such as joints, bones, and endocardium, are conceded by all to be hæmatogenous in origin. The origin of disease in organs directly or indirectly connected with the surface of the body, such as the stomach, gall-bladder, pancreas, and appendix, is still considered by many to be due, in the main, to direct infection through the mucous membrane lining the intestinal tract or the ducts which drain into it. Many facts suggest that in these, too, the infection may be blood-born. The lesions in the early stages or milder forms of infection in these structures are often sharply circumscribed, hæmorrhagic, and situated in the mucosa, submucosa, or peritoneal coat, with no evidence of a diffuse involvement of the mucous membrane. The fact that the changes in pancreatitis are usually more marked in the head of the pancreas is quite generally considered evidence of an ascending infection through the ducts. But this does not follow since I have found that the same is true in pancreatitis from the intravenous injection of bacteria having affinity for this organ.

Experiments to produce ulcer of the stomach by feeding bacteria have been unsuccessful except in starving animals. In my (17) work ulcer of the stomach could not be produced even when streptococci, proved to produce ulcer on intravenous injection, were fed in larger quantities. The addition of sharp particles to the diet containing the streptococci was also of no avail.

Streptococci proved to have an affinity for the gall-bladder when injected intravenously failed to produce cholecystitis when injected directly into the lumen of the gall-bladder (18).

Intravenous injection of streptococci, and in some instances of colon bacilli, from acute appendicitis has been followed by marked localization and lesions of the appendix of rabbits (19), whereas attempts to produce appendicitis by way of the mucous membrane have been unsuccessful unless the blood supply is markedly interfered with.

From these facts and many others it is certain that the normal mucous membrane of the intestinal tract affords marked protection against invasion of the bacteria usually found in ulcer of the stomach, cholecystitis, and appendicitis. A break in continuity or increased permeability of the lining cells from trauma, or otherwise, appears necessary for local invasion, whereas in hæmatogenous in-

[1] Mayo Foundation Lecture, delivered February 11, 1921.

fections the bacteria appear to gain entrance into the blood stream chiefly through a chronic localized focus of infection.

The place of localization of bacteria after entrance into the blood stream, aside from the well known factor of trauma, or the *locus minoris resistentiæ*, has been considered as more or less accidental. Many facts indicate that this is not the rule and that delicately balanced conditions must prevail before localization and growth of bacteria can occur in a given tissue. The blood stream is invaded by the typhoid bacillus in typhoid fever, yet the lesions are limited to Peyer's patches and other lymphoid structures in the intestinal tract. The pneumococcus enters the blood in practically all cases of lobar pneumonia, yet localization remains limited to the lungs and pleura. The streptococcus viridans has been isolated from the blood daily for weeks and even months in chronic septic endocarditis, but localization remains limited to the endocardium. The lodgment of even millions of these streptococci, as occurs in emboli, from the vegetations is not sufficient to insure continued growth in tissue other than the heart valves.

In the infectious diseases the properties of specific micro-organisms determine their localization. The idea that localization may be determined by peculiar properties in different strains of the same species of bacteria, or of even the same strain when subjected to different conditions, had its origin in my experiments some years ago in which changes suggesting true mutations were induced in the pneumococcus-streptococcus group of organism (15). The idea was placed on substantial ground when the streptococcus viridans from endocarditis and other strains of streptococci of low virulency were passed successively through animals. The localization following intravenous injection changed as the infecting power increased. At first hæmorrhages in the heart valves and endocarditis were the chief findings. Later lesions in and around joints, in muscles, especially the tendinous end, and eyes, especially iritis, developed. Still later lesions of the kidneys and of the stomach developed, and finally, as the virulency became high, death occurred from invasion of the blood stream without focal lesions.

The findings in the stomach were particularly instructive (16). The hæmorrhages and ulcerations were found to be due to localized infection. The ulcers were often single and deep, and showed, as those in man, marked tendency to hæmorrhage and perforation. Generalized infection did not occur. The theory that the usual type of gastric ulcer may be due to streptococci was proposed at that time. The supposed relation between infected tonsils or teeth and gastric ulcer was, in the light of the experiments, considered to be due not to the swallowing of bacteria, as usually supposed, but to the entrance into the blood of streptococci of the proper kind of virulence to produce local infection in the wall of the stomach. It was through these experiments that the idea of the elective localization of bacteria took definite form, and I have since studied the pathogenesis of various diseases from this standpoint.

The cultures from excised tissues and from foci of infection have been made by special methods which offered a gradient of oxygen tension, a point not sufficiently considered by some workers along this line. The localizing powers of the freshly isolated strains of the bacteria isolated from the tissues, and, owing to the work of Billings on focal infection, those from the focus as well, have been measured by intravenous injection in animals. The results obtained have been published from time to time, and for details reference should be made to the original reports. In this paper I wish to review briefly the results obtained in the earlier work in ulcer of the stomach, cholecystitis, and appendicitis, diseases of especial interest to surgeons, and to record further studies along similar lines.

## RESULTS IN THE EARLIER STUDIES

Streptococci were found to be the most important organism in the tissues in each of these diseases. They were chiefly of the non-hæmolytic type, of a low grade of virulence, and culturally much alike. Wide differences in inherent properties, however, became apparent on intravenous injection. The streptococci tended to localize and produce lesions

in organs corresponding to those in the diseased persons from whom they were isolated. This was true of the strains from tissues as well as of those from infected tonsils or other foci of infection. Thus 68 per cent of sixty-eight animals injected with fourteen strains from appendicitis developed hæmorrhagic lesions of the appendix (19); 60 per cent of 103 animals injected with eighteen strains from ulcer showed hæmorrhage and ulcer of the stomach (17); and 80 per cent of forty-one animals injected with twelve strains from cholecystitis developed lesions in the gall-bladder (18). This was in sharp contrast to the incidence of lesions in these organs (3 per cent, 17 per cent, and 4 per cent respectively) following injection of forty-four animals with thirty-four strains of streptococci from miscellaneous sources. The lesions which developed in the respective specific organs were not only more common, but were often more marked when lesions in other organs were slight or absent. Moreover, the strains from acute ulcer, cholecystitis, and especially appendicitis, produced lesions more marked than those from the chronic forms of these conditions.

The demonstration that streptococci in infected tonsils and teeth may have elective localizing power placed these so-called harmless infections, teeming with bacteria, in the front rank in importance as sources of hæmatogenous infections. Corroborative clinical evidence indicating causal relationship between the focus of infection and systemic disease is not lacking. The foci are present in demonstrable form in a high percentage of patients with the diseases under consideration. Acute attacks often follow exacerbations of infections in sinuses, tonsils, and teeth. Evans has noted a marked increase in the incidence of appendicitis during epidemics of sore throat. The average time that elapsed between the respiratory infection and the onset of appendicitis was sixteen days (5). The presence of streptococci having elective affinity for the appendix has been demonstrated in the tonsils at the time of acute appendicitis following tonsillitis, and their absence as recovery ensued (19). This I have shown also in cases of ulcer following acute infection in tonsils and sinuses (17), a fact in strict accord with the increased incidence of symptoms in ulcer during the months when these infections are prevalent, as first noted by Moynihan. Metastatic infection in other parts, such as the joints and the endocardium, commonly occur, not at the height of the nasal and tonsillar infection, but some time later. It appears that the bacteria acquire elective localizing power in the focus and that the various diseases may be manifestations of phases in the infecting power of the same micro-organism. The symptoms in the systemic condition often improve when foci of infection are removed unless mechanical factors have come to play an important part in their production. However, not too much value should be attached to purely clinical observations on this point. It is very difficult to know at a given time whether a suspected primary focus is responsible, whether other foci exist in inaccessible parts, whether a previous removal of a focus has been thorough, especially if in the dental area, whether the foci removed actually harbored the bacteria with which the disease could be reproduced, and finally whether in a given case, especially if chronic, the infection has not become so thoroughly established as to tend to progress independently of the focus.

My original experimental studies in ulcer (17), cholecystitis (18), and appendicitis (19), extended over a short period, and included a relatively small series of cases. The results were on the whole contrary to current opinion, especially in ulcer. Some investigators have had difficulty in corroborating my findings. The number of bacteria injected was relatively large and this has been objected to. I believed it worth while, therefore, to continue the studies in a larger and more varied series, including recurrent ulcer, and to test the effect of the injection of smaller doses of bacteria. This has been done as occasion developed during the past 5 years. The method of study has been similar to that in the earlier work. In all the cases the symptoms were active at the time of the study and in all there were foci in which a casual relationship was suspected. Painstaking effort was made to obtain cultures from the depths of the focus and to eliminate as far as possible the more

saprophytic bacteria on the surface. Glucose-brain broth in tall columns was substituted for ascites-glucose broth. The dose for a routine injection consisted of from 0.1 cubic centimeters to 0.25 cubic centimeters for each 100 grams of body weight. Usually only one injection was given. In order to rule out all possible objections to dosage, the small amount of pus expressed from tonsils and emulsions of tonsils was injected directly. The primary culture in glucose broth was usually injected and the identity of the causative organism determined by plating the culture, by making cultures of the tissues showing lesions, and by making control cultures of the blood and normal mucous membrane of the stomach and other organs showing no lesions.

RESULTS IN UNPUBLISHED EXPERIMENTS

In the series sixty-five animals (fifty-nine rabbits, four dogs, and two guinea pigs) were injected intravenously with the cultures from nineteen cases of ulcer of the stomach or of the duodenum. Thirty-two of these were injected with cultures from the tonsils, six with the bacteria in the pus from the tonsils, seven with the streptococci isolated from three excised ulcers, and twenty-three with the cultures from infected teeth. The incidence of lesions in the stomach and in the duodenum was about equally high in each of these groups. Hæmorrhage or ulcer, or both, developed in fifty-two (80 per cent) of the animals injected. The lesions in other organs were either wholly absent or relatively slight. Fifteen animals showed lesions in the gall-bladder beside those in the stomach, seven showed a few lesions in the skeletal muscles, five in the joints, one each in the kidney and the urinary bladder, and nine hæmorrhages in the heart valves. The lesions in the stomach consisted first of areas of hæmorrhage varying greatly in size and shape, and later of one or more ulcers. The ulcers were usually situated along the lesser curvature and the pyloric end. Ulceration usually occurred first in the center of the hæmorrhagic areas and extended to the submucosa or muscularis. In some instances the ulcer formed in circumscribed, grayish, swollen, necrotic areas free from hæmorrhage. The base at first was hæmorrhagic, but later became clean and free from necrotic tissue. Usually there was no infiltration or hyperæmia of the overlying peritoneum.

All the six animals injected with the bacteria which had grown in the tonsil developed striking lesions in the stomach or duodenum. Three of these did not have lesions elsewhere, and three had hæmorrhage of the tricuspid valve in addition, but no other lesions. Only four animals died from the effects of the injection, two in one day, and two in two days. The rest appeared well when anæsthetized, usually in from 2 to 3 days after the last injection. The streptococcus was found in the blood in all the animals that died, but it was found in only three of thirty-one that were anæsthetized and in which the blood was cultured. Cultures were made of the excised areas of hæmorrhage or ulcers in seventeen animals. Of these fifteen yielded the streptococcus, and two were sterile. Control cultures were made of the normal mucous membrane of the stomach, the liver, the spleen, the kidneys, and the brain in twelve animals showing ulcer. These and the blood were sterile or showed relatively few streptococci compared with the number isolated from the lesions in the stomach.

Since my last report on ulcer, tissue cultures have been made from twenty-seven chronic ulcers excised at operation. Streptococci were isolated in eighteen, colon bacilli in five, staphylococci in six, and six showed no growth. In all of the latter healing was well advanced. Control cultures were made of the tissues in carcinomatous ulcers from eleven patients. In these streptococci were found in only two, colon bacilli in five, and staphylococci and Welch bacilli in two each.

The history of ulcer symptoms in the cases studied ranged from 6 months to 21 years. The ages of the patients ranged from 27 to 53 years. All had active symptoms at the time of study, and two had had gastric hæmorrhages a short time previously. Only four had a history of attacks of tonsillitis; two of these had arthritis in addition to ulcer. In none were the tonsils acutely inflamed; most of them were small and contained a large

TABLE 1.—ELECTIVE LOCALIZATION OF STREPTOCOCCI IN ULCER OF THE STOMACH, CHOLECYSTITIS, AND APPENDICITIS

| Source of streptococci | Strains | Animals | Percentage of animals showing lesions in | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Eyes | Teeth | Skin | Muscles | Joints | Intestines | Appendix | Stomach and duodenum | Gall bladder | Kidneys | Lungs | Pericardium | Myocardium | Endocardium | Nerves | Central nervous system |
| Ulcer of stomach | 37 | 168 | 0 | 4 | 0 | 4 | 12 | 4 | 1 | 68 | 21 | 3 | 2 | 2 | 3 | 13 | 0 | 2 |
| Cholecystitis | 12 | 41 | 0 | 0 | 2 | 7 | 17 | 17 | 0 | 20 | 80 | 5 | 5 | 0 | 2 | 12 | 0 | 2 |
| Appendicitis | 17 | 71 | 0 | 0 | 0 | 12 | 29 | 9 | 70 | 11 | 1 | 0 | 0 | 0 | 0 | 21 | 0 | 2 |
| Myositis | 24 | 169 | 0 | 7 | 3 | 75 | 31 | 0 | 0 | 15 | 2 | 11 | 7 | 6 | 14 | 11 | 11 | 2 |
| Acute poliomyelitis | 22 | 128 | 0 | 2 | 0 | 10 | 13 | 5 | 2 | 13 | 2 | 2 | 11 | 5 | 7 | 7 | 4 | 2 |
| Miscellaneous | 71 | 212 | 4 | 5 | 4 | 12 | 9 | 4 | 1 | 9 | 1 | 9 | 7 | 0 | 4 | 13 | 1 | 2 |

pocket at the pole from which pus could be expressed. The cultures from dental foci were chiefly from infected areas in the apical region of devitalized teeth. The size of the areas of rarefaction around the teeth varied greatly. In some it was slight, in others marked. All were symptomless. In no instance did these areas contain visible pus, and none communicated with the surface through a sinus. Tonsillectomy was advised and performed in four cases because of the striking localization of the streptococci in the stomach of the animals. Improvement in ulcer symptoms followed in each patient. In three cases elective localization occurred with streptococci both from the tonsils and the teeth, and in two with the streptococcus from the tonsils and from the ulcer. No localization followed intravenous injection of the streptococcus from the focus in two cases, nor from the excised ulcer in one case.

### SUMMARY OF RESULTS IN ILLUSTRATIVE CASES

There were two cases of ulcer in the series in which the cultures had affinity for the mucous membrane of the stomach and for the mucous membrane of the gall-bladder. The relatively high incidence (21 per cent) of lesions in the gall-bladder, shown in Table 1, is due in large part to these two cases. In one of these a chronic indurated ulcer of the lesser curvature of the stomach was excised, and a distinctly thickened and hyperæmic gall-bladder, with swollen glands, was found. The patient made a good recovery from ulcer symptoms, but subsequently developed typical attacks of cholecystitis. The streptococcus from the tonsil was isolated, and after one and two animal passages was injected into six animals —five rabbits and one dog. Marked lesions in the stomach or duodenum developed in all, and two showed lesions of the gall-bladder in addition. The other case had a perforating ulcer of the duodenum without evident lesions of the gall-bladder. The streptococcus from the tonsils was injected into nineteen animals. Fifteen received a pure culture in the first, second, and third animal passages, two a mixture of the streptococcus and colon bacillus in the primary culture from the tonsils, and two the mixture of bacteria in the pus directly from the tonsils. Fourteen (74 per cent) showed hæmorrhages or ulcer of the stomach or duodenum, nine showed lesions of the gall-bladder in addition, and four showed cholecystitis only. The lesions in other organs were few. Two showed hæmorrhages in the heart valves, one slight arthritis, and one a few lesions of the kidneys.

Five rabbits were injected with the colon bacillus in the second and third animal passages. All developed cholecystitis, and three slight hæmorrhages in the stomach or in the stomach and duodenum. One additional rabbit injected with the strain in the fourth passage died of overwhelming infection without developing focal lesions anywhere.

Localization in the stomach and duodenum was in general the striking picture following the injection of the streptococcus. The lesions in the gall-bladder were relatively slight and consisted usually of localized necrotic areas surrounded by hyperæmia and infiltration, but marked diffuse œdema with fibrinous exudate did not occur following injection of the streptococcus alone. Following the injection of the colon bacillus the picture was reversed. The lesions in the stomach were slight, while those in the gall-bladder were marked. The most marked lesions in the gall-bladder, however, occurred when a mixture of the streptococcus and colon bacillus was injected.

We have had the rare opportunity to study the elective localizing power of the bacteria from infected teeth in a man who had recurring attacks of ulcer with hæmorrhage, and on whom a gastro-enterostomy had been performed 12 years before. No attention was paid to the question of foci of infection at that time. After the surgical removal of five infected teeth the patient's symptoms gradually disappeared under medical management, although heretofore his condition had been refractory to this treatment. The streptococci from the granulomata of three teeth and from one devitalized tooth which showed no granuloma were injected into four rabbits. The animals appeared well 48 hours later, when anæsthetized. All showed hæmorrhages and ulcer of the stomach. The ulcers were situated along the lesser curvature and in the pylorus. Three of the four rabbits showed hæmorrhage and œdema opposite the roots of the lower incisors. No other lesions had developed.

The results of the animal experiments performed in connection with a patient having symptoms of chronic cholecystitis without stone, and chronic pancreatitis with achlorhydria, representing the type described by W. J. Mayo, emphasize still further the importance of studies of focal infection and elective localization. This patient complained of distress after eating, repeated attacks of moderately severe pain in the regions of the gall-bladder and pancreas, of recurring attacks of diarrhœa, and marked loss in weight (60 pounds). A general examination was negative except for slight tenderness in the right hypochondrium. Two devitalized abscessed teeth were found and removed, and one abscess in the upper jaw where a tooth had been extracted years before was drained. The patient continued to lose weight. Six months later the tonsils were removed. Following tonsillectomy the patient regained health and most of her former weight.

The primary culture from the tonsil was injected into one rabbit and three dogs. One of the dogs died in 24 hours; the other two and the rabbit were chloroformed in 48 hours. The picture was most striking. All four animals showed lesions of gall-bladder, pancreas, and stomach. The gall-bladder and pancreas were hæmorrhagic and œdematous. The lesions in the pancreas were more marked in the head. The stomach appeared very different from stomachs following injection of the ulcer strains. The acid-secreting portion of each was extremely hyperæmic and showed numerous fine superficial hæmorrhages, while the pyloric end was normal. The streptococcus isolated from the œdematous fluid surrounding the pancreas in one of the dogs was then injected into a dog and into a pregnant cat. Marked lesions of the gall-bladder and pancreas developed in both, but the stomach in each was spared. The cat aborted and the one nearly full-grown fœtus available for examination showed hæmorrhagic fluid in the peritoneal cavity, and marked œdema and small hæmorrhages of the pancreas. Cultures from the lesions in the pancreas of the fœtus, of the pancreas and gall-bladder in the mother cat, and of the pancreas and gall-bladder in the dog yielded the streptococcus injected.

About 1 year after tonsillectomy the patient again began to lose weight and strength. At this time three encapsulated roots of teeth were found and removed surgically. Cultures of two yielded green-producing streptococci; the other was sterile. Injection again showed similar localizing power, and with the removal of these foci the patient again improved.

During the course of the 5 years careful necropsy records have been kept of the lesions

found after intravenous injection of cultures from tonsils, and so forth, in diseases other than ulcer in which elective localization was not obtained, as well as in normal individuals. These have been compiled to serve as control experiments. Of a total of 212 animals injected with seventy-one strains only twenty (9 per cent) revealed significant hæmorrhages or ulcer of the stomach or duodenum. This low incidence was not due to a lower general virulence of the streptococci injected, because in this series the total mortality was nearly five times as high as in the ulcer series. The incidence of lesions in organs other than those in the stomach or duodenum was higher and occurred in a larger number of different organs. The muscles, joints, and kidneys ranked highest, the incidence being 12 per cent, 9 per cent, and 9 per cent respectively (Table 1).

Among the diseases studied in the miscellaneous group were acute myelogenous leukæmia, urticaria, ulcerative colitis, bronchitis, elephantiasis, thyroiditis, diabetes, purpura, jaundice, epididymitis, acute pyorrhea, dermatitis, and angina pectoris. Many of the cultures injected were obtained from tonsils or teeth of persons who were well at the time of the experiments. Moreover, an additional check on these experiments is given by the low incidence of lesions in the stomach and duodenum following injection of streptococci from other diseases in which elective localization was demonstrated. Thus lesions in the stomach and in the duodenum developed in only 13 per cent of 123 animals injected with cultures from twenty-two cases of acute epidemic poliomyelitis, in 6 per cent of eighteen animals injected with cultures from the tonsils in four cases of neuralgia, and in 14 per cent of 159 animals injected with streptococci from twenty-four cases of myositis (Table 1).

In Table 1 is given a complete summary of the localization of streptococci obtained from ulcer, cholecystitis, and appendicitis, and, as controls, localization of streptococci from myositis, from acute poliomyelitis, and from miscellaneous sources. The incidence of lesions in the various organs is given in percentages so that the figures are directly comparable.

## DISCUSSION AND SUMMARY

In view of the large number of animals injected and the wide range of the source of the streptococci, the incidence of lesions in the various organs following injection of nonspecific strains may be considered an expression of their relative susceptibility to infection. It will be noted in this series, as in my former studies, that lesions in the joints, the muscles, the stomach and duodenum, and the endocardium rank highest, which corresponds in general to the frequent occurrence of spontaneous infections in these structures in man and animals.

The occurrence of lesions in the gall-bladder and in the pancreas of animals following injection of bacteria from the case of suspected cholecystitis without stone and with pancreatitis, and the relatively high incidence (21 per cent) of lesions in the gall-bladder following injection of the ulcer strains, and in the stomach and duodenum (29 per cent) following injection of the gall-bladder strains, suggests that the common association of two or more of these conditions in man may also be due to embolic infection by bacteria having affinity for the structures involved.

The demonstration that the foci of infection in tonsils and teeth, so commonly noted in patients with ulcer of the stomach, cholecystitis, pancreatitis, or appendicitis, contain bacteria which reproduce these respective diseases in animals, suggests strongly that such foci must be important factors in the production of these conditions in man. A focus of infection that is teeming with micro-organisms, wherever found, it may be in the intestinal tract, which for mechanical reasons can neither heal nor drain, should be regarded as a test tube with permeable walls embedded in the tissues. In consequence the continued growth of the living bacteria and their products ultimately tends to overwhelm the protective mechanism of the host.

The careful elimination of foci of infection should become a routine procedure in both the medical and surgical management of these diseases. The focus should be removed before the mechanical factors, such as much scar tissue in chronic ulcer, gall-stones in

cholecystitis, and fæcal concretions or kinks from adhesions in appendicitis, have come to play a dominant part. The benefits should be especially noticeable in preventing acute attacks, in diminishing the number and severity of exacerbations in the chronic conditions, and in reducing the incidence of gastrojejunal ulcer after gastro-enterostomy, as emphasized by Eusterman and by Judd. The elimination of visible foci, however, will not prevent all these infections. The invasive power of the bacteria may be so great in some instances that forced entrance, as occurs in a focus, is not essential, and entrance may be gained through the unabraded mucous membrane as in acute infectious diseases.

In the light of these experiments the place of localization after entrance into the blood stream depends largely on the peculiar infecting powers of the bacteria themselves. The fact that the peculiar infecting powers of the streptococci are lost on artificial cultivation, as well as on animal passage, would indicate that the strains isolated in these diseases are not specific, but modifications of the same strain. The reasons for the common presence in these diseases of organisms with respective elective localizing powers, again demonstrated in this study, are still obscure.

The elective localizing power of the colon bacillus has been demonstrated in cholecystitis and appendicitis, but only rarely. The results of the cultures of the tissues removed at operation and of the animal experiments indicate strongly that the colon bacillus is usually a secondary although important invader, especially in acute cholecystitis and appendicitis, and that it plays only a minor part in the etiology of ulcer of the stomach.

The results of my former studies have been corroborated and extended (2, 3, 6, 7, 8, 12, 14). The production by Mann of a specific cholecystitis by the intravenous injection of Dakin's solution supports the idea of elective localization from the chemical standpoint. The criticism of the size of the dose injected in my previous work has been met; the small number of bacteria from foci injected directly has been followed by elective localization. Streptococci have been found most constantly in the infected tissues and foci of infection in each of these diseases. They were usually the only organisms that had elective localizing power. With them the diseases, including ulcer, have been reproduced in animals. They have been repeatedly isolated from experimental lesions and the diseases again reproduced. The requirements for causal relationship of parasite and disease appear to be fulfilled. The conclusion that streptococci are the chief cause of ulcer of the stomach, cholecystitis, and appendicitis, and, probably, pancreatitis, seems to be justified.

I wish here to express my appreciation to members of the staff of the Mayo Clinic through whom this work was made possible.

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# AN ESTIMATE OF THE VALUE OF LOCAL ANÆSTHESIA IN THE SURGERY OF TODAY[1]

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OUR Association exerts a widespread influence in molding medical opinion, hence this appeal for you to champion a cause to which several of our Fellows have made notable contributions. This matter forces itself upon our attention since a survey of the busy clinics indicates that a few authorities go to one extreme or the other in the matter of local anæsthesia, that some unite on the rational viewpoint of it having a certain, definite field of usefulness, while many consider it not at all.

We shall concern ourselves today largely with a recital of the impressions which have been gained by many years' observation of a large number of patients before, during, and after the employment of local anæsthesia of one sort or another, confining the discussion to methods that are highly practical, thoroughly safe, fairly easily acquired, and a part of the daily routine in my own clinic. This should then resolve itself into an intimate consideration of how and why we use local anæsthesia, together with a summary of our results. I may state that it has been written in part by the patients themselves, dealing as it does with their impressions which, indeed, are often expressed in their own words.

No more than passing reference will be made to the age-old use of cold, pressure, constriction, and other procedures for the production of local anæsthesia. They were rendered obsolete when two discoveries of the first magnitude made the infiltration technique possible, viz., invention of the hypodermic syringe by Wood, in 1853, and injection by von Anrup, in 1879, of cocaine under the skin of his arm, followed by the development of an anæsthetic area. It remained, however, for the American, Corning, to have the distinction of being the first to make a clinical application of this knowledge to surgery.

One needs no more than mention that there are six methods of employing the local anæsthetic agents of today, (1) direct infiltration of the field; (2) circular infiltration about the field; (3) nerve blocking, in which the agent is injected directly around or into an isolated nerve; (4) intravenous injection; (5) arterial injection, and (6) surface application.

For the purpose of general surgery, we may well confine our attention to the first three procedures, since the intravenous method has a narrow field, the arterial is attended by obvious disadvantages, and surface anæsthesia is used only in the limited surgical specialties.

## PSYCHOLOGICAL CONSIDERATIONS

I am indebted to Professor Swift of Washington University for his assistance in interpreting some of the interesting psychological aspects of the local anæsthesia problem. One who studies the subject from this point of view early notes that there is in different patients a marked individual difference in receptivity to pain stimuli, which is largely influenced by race, nationality, sex, age, intelligence, character, training, state of health, fatigue, and surrounding influences. Nor is it pain alone which we have to control; our problem is, at the same time, to combat the anticipation of pain and the age-old fear of pain. Our problem should then be undertaken before the sufferer enters the operating room proper, and has to do not only with the patient, but with the patient's point of view. We might even go farther back than this and safely make the statement that public appreciation of local anæsthesia is secondary in importance only to the intrinsic value of the procedure itself. Only in this way can it come about then that many an individual may be influenced to have a needed operation done after being long held back by the dread of a general anæsthesia. This is, I think, particularly true of patients who come to the surgeon for the second time after once having had a general narcosis, a fact which is especi-

[1] President's address read before the Southern Surgical Association at Hot Springs, Virginia, December 15, 1925.

ally impressed upon one by the individual whose first convalescence has been unsatisfactory to him. I have in mind now a gentleman whose sigmoid we resected for cancer, under ether; he experienced pneumonia, empyema, thrombophlebitis, and a postoperative hernia in consequence. It was many months before this patient returned to his accustomed health, and then, as may be easily imagined, he never considered a repair of his incisional hernia until told that this could be readily accomplished without a general anæsthesia

A wonderfully steadying effect is exerted upon a prospective local anæsthesia patient by allowing him to talk with one who has experienced this form of treatment. In most instances, this does more than anything else known to me to inspire confidence in the method. An expression of the same idea impressed me recently, when a father desired his son to witness the performance of a double herniotomy under infiltration, his reason for this unusual request being that the younger man also needed a herniotomy, but had withheld consent because he was afraid of an anæsthetic. I am inclined to think that the greatest good to the greatest number might be accomplished under such circumstances by relaxing the ordinary operating-room rules in as far as they apply to visitors.

A patient who has gone through one operation under local anæsthesia, is in my experience, more amenable to a second undertaking of the same character, than is the individual who has once been under ether. I recall to memory just now a prominent attorney who had taken ether years before I saw him. Then I repaired a right-sided inguinal hernia for him, under infiltration. About one year later, after indulging in athletics of unusual violence, he returned to me with a hernia on the left side. He made light of the prospect of a third operation, because, as he said, he did not now have to take ether; surely he should have been in a position to judge because he had had experience with both the general and the local methods.

In their opposition to a general anæsthesia, many patients reason that a drug which renders them unconscious is a highly potent agent which might conceivably interfere with the truly vital functions, and surely one cannot be blamed for considering seriously any such profound alteration in the course of his ordinary existence. It does not require much of a psychologist to reason that one who enters a state of somnolence so deep that pain cannot affect him may conceivably never awaken again; however, it remains for the surgeon to balance the relative risks of the two procedures against one another, but the ideal solution of the problem may be said to exist when the view-point of the patient coincides with that of his medical adviser.

The psychological tendencies of people differ in the matter of remaining awake on the operating table. One may say: "I do not want to know anything about the procedure; I know I shall not be hurt, but I cannot bear the thought of being awake in an operating-room and of being cut." On the other hand, another may say: "I do not wish to lose consciousness for a single moment. I want to know what is going on, even at the expense of some pain." The surgeon, who is a student of psychology, humors the natural tendencies of either type of patient; it is a very good plan in many instances not to bring up a discussion of an anæsthesia until the operating room has been reached, unless the patient has demanded a consideration of this matter beforehand. A reasonable individual has so much confidence in the surgeon selected that he is likely to co-operate in whatever is suggested, hence there is no special reason for burdening him with details which he often cannot clearly comprehend and which may merely cause him uncertainty and worry. Again, it sometimes does very little good to map out a definite and inelastic plan, since one cannot foretell how even a willing patient will react under local anæsthesia until the operation has commenced. Here, as elsewhere in medicine, every patient is to some extent a law unto himself and demands individual treatment.

### CONSIDERATION OF THE DRUGS EMPLOYED

Paul Ehrlich named the drugs which produced local anæsthesia "anæsthesiphores," according to the grouping of their atoms.

The anatomical grouping of cocaine was first determined, then reproduced synthetically, and the newer local agents, such as novocaine, were the result of further study along the same line.

It is pretty generally admitted that such an agent to be acceptable must fulfill certain, necessary requirements: it is to be soluble in water; it must stand boiling; it must combine with adrenalin; it cannot be more than mildly toxic, cannot be irritating during injection, nor must it produce permanent injury to the tissues.

All the chemicals in this group work in very much the same way, but some of them are highly irritating for the moment, others produce a transient effect, some like cocaine are highly toxic, and others exert considerable tissue damage. Local agents act as anæsthetics because they are soluble in the lipoids of the peripheral nerves, and most experimenters consider their action to be physical rather than along chemical lines. These agents have a special affinity for sensory nerves, affecting them earlier and much more profoundly, and for a longer time than they do the motor variety. This selective action may quite well be due to the fact that in mixed nerves at least the sensory fibers are said to run on the outside of the nerve bundles.

All of these local agents in addition to being protoplasm poison, are at the same time toxic in the general sense by their effect on medullary centers; they are dangerous in proportion to the dose used and to the rapidity of absorption. Their general toxicity is inhibited on the other hand by many things which retard absorption, viz., cold, constriction, or the admixture of adrenalin. The respiratory center in the medulla is the first to suffer and the one most deeply affected, hence prolonged artificial respiration may in some instances be the means of saving life.

Exhaustive experiments have shown that novocaine, now produced in this country under the name of procaine, better than any other drug fulfills all the requirements mentioned. It is only one-tenth to one-fifth as toxic as cocaine, according to the animals on which we have experimented. It is non-irritating and produces absolutely no tissue damage. It can, however, be used in quantities large enough to cause death, as we have frequently demonstrated on animals, respiration ceasing long before the heart stops beating. Six ounces of ½ per cent solution of novocaine, poured into the peritoneal cavity of a 15-pound dog, caused death from respiratory failure in about 20 minutes. Naturally enough, a drug which conceivably produces death may surely be said to exert a general effect when used as a local anæsthetic. I think this is frequently observed in our surgical clinics when comparatively large amounts of the drug are used. We have, however, used 8, 10, 12, and in a few instances, 16 ounces (500 to 1,000 cubic centimeters) of a ½ per cent infiltration solution, without observing serious toxic consequences. Of course, a very large amount, if used at all, must be injected over a considerable period of time and absorption delayed by adrenalin.

I may state in passing that very little difference has been observed in our clinic between the effects of one-half and one-fourth per cent novocaine in infiltration, although this runs counter to the experiments of most operators. I find, too, that the effect of novocaine in ½ per cent solution lasts no longer than 2 to 4 minutes unless adrenalin has been added; however, others, whose opinions I value, differ with me on this point. The use of adrenalin, on the other hand, greatly lengthens the effect of a ½ per cent infiltration. In one instance I infiltrated the anterior of the neck for a thyroidectomy, then was delayed by a surgical emergency from beginning the operation, and when finally the skin suture was finished 2 hours and 20 minutes after the injection of the neck, the anæsthesia was still practically perfect. It is hardly fair to dismiss this phase of the subject without mentioning at least that tissue changes, which have been blamed upon local agents, have to my definite knowledge been due to the fact that isotonic solutions were not used. It goes without saying, then, that novocaine or any similar agent is to be dissolved in physiological salt solution rather than in sterile water.

EFFECT ON DIFFERENT TISSUES

All who have investigated the response of the different tissues to pain stimuli agree pretty well that the skin is much more sensitive than are the other structures of the body. This is particularly true of the finger tips, and least so of the skin of the back, other areas approaching one or the other extreme in about the proportion that they are commonly exposed to pain stimuli. Muscle sheaths are highly sensitive and must be treated accordingly. Muscle and fat, on the other hand, are much less so, and may be handled with a certain degree of impunity, unless a vein or a nerve be encountered. Periosteum is acutely sensitive on areas which lie superficially beneath the skin, but less so in other parts of the body. The nerve supply of bone comes from the periosteum, hence bone sensation is largely dependent upon the treatment of the periosteum; indeed, bone is said to be practically anæsthetic if the periosteum has been removed.

Inflammatory affections of all tissues make them just as acutely sensitive to the injection of local agents as they are to all other forms of stimulation. Œdema, on the other hand, is generally thought to decrease tissue sensibility.

THE ADVANTAGES OF LOCAL ANÆSTHESIA

It is difficult to summarize in a logical manner the advantages of this method, since the needs of each patient are so highly individual, but one may sketch them in a general way. Not the least of them is the cooperation of the patient which we must secure at every stage of a procedure under properly conducted local anæsthesia. This is especially valuable in demonstrating the voice during thyroidectomy, in finding the sac of a hernia, or in coapting the edges of an abdominal incision which would be hard to close under ordinary circumstances. One may be practically sure, if his technique be correct, that he creates no immediate danger to life but escapes the possibility of a death on the table—the most shocking circumstance possible in connection with a surgical operation, for the fear of death on the operating table is more likely than anything else to deter patients from entering the operating room. With local anæsthesia, we greatly lessen the danger of operative shock, since, when we operate with any form of local anæsthesia, we do so with all centripetal stimuli cut off from the cerebral centers, something which is, as Crile has so well shown, not true with general anæsthesia alone. A refining influence is also exerted upon the operator's technique, since crude, rough work cannot be done without a general anæsthetic. We also greatly reduce the mortality of surgery, by decreasing the likelihood of postoperative complications, which may prove fatal, such as pneumonia, organic parenchymatous degenerations, etc.

No necessary detail of a multiple operation has to be omitted, since there is not the risk which attends a prolonged ether anæsthesia, having in mind, of course, a due regard for the patient's state of fatigue, which can be minimized by the use of morphine, during a lengthy procedure.

There are none of the immediate complications which so frequently are noted just after the patient regains consciousness, such as restlessness, sweating, mucus in the bronchial tree, nausea, sore jaw or tongue, and conjunctivitis, the last three due to manual carelessness of an anæsthetist. Then, we do not see the same amount of postoperative pain after local as after general anæsthesias, due no doubt to the patient's undiminished ability to endure it. However, I must not dwell too strongly upon this comparison, since there is some reaction after a cutting operation, no matter what form of anæsthesia may be used.

Some may urge, in criticism of the method, that it requires special training, that a surgeon must be particularly skillful and gentle to use it, and that all local anæsthesias are not quite equally successful, that it is somewhat time consuming and that it is not equally adapted to all procedures. These are all criticisms which reflect lack of experience or of refinement on the part of the one making them, and I believe they are heard less frequently as knowledge of the subject becomes more and more widespread.

### INDICATIONS FOR LOCAL ANÆSTHESIA

The indication for local anæsthesia is far from universal. It depends first of all upon the ability and inclination of the surgeon, to say nothing of the condition and attitude of the patient, as well as his age, race, training, and intelligence, all of which must be taken into consideration. Local anæsthesia may be reasonably considered indicated in obstructive conditions of the air passages, inflammatory respiratory trouble, circulatory decompensation, acute abdominal emergencies, renal insufficiency, toxic conditions (goiter, etc.), chronic alcoholism, marked obesity, and in very old age. The same is true if a general anæsthesia has been used in the very recent past, and if the patient must for any reason become ambulatory immediately after the operation. Many consider local infiltration anæsthesia especially indicated in fractures and dislocations, arguing that a patient who is awake can co-operate with a surgeon in applying splints and preserving the contour of plaster until it is dry. In a simple fracture, the tissue bag thus created is filled with one-half per cent novocaine and the muscles are completely relaxed in consequemce, while it is claimed for a dislocation that the rent in a capsule full of fluid is much more easily found than that in one that is empty, as ordinarily seen.

### CONTRA–INDICATIONS

There are a few definite contra-indications, in my opinion, to the use of local anæsthesia. Perhaps with increasing experience and more study of the subject, some or all of them may be modified or removed. However, at the present time, I do not believe that any form of local anæsthesia is advantageous with patients at an age when they cannot co-operate with the surgeon, still, I am perfectly aware that some men, experienced in this line, following Farr's example, operate on very young children with satisfaction.

I believe local anæsthesia to be contra-indicated in a case where the patient has an unreasoning fear of it, or in one who manifests unwavering opposition to it, or in one whose nervous system is not under fair control. It may be used in these classes of patients with good results however, if it is masked by gas or by a very light ether anæsthesia. This is really a phase of the subject which cannot be taken too seriously, since a lack of co-operation from a refractory patient has prevented us more than once from getting the local agent into the desired region, with a correspondingly imperfect anæsthesia as a result.

In May, 1920, a young man applied to me for a herniotomy under local anæsthesia, but after he had fainted during a physical examination, which was not in the least exacting, he of his own accord very wisely suggested the substitution of ether. This was done and I think would have been done by almost any surgeon who considers the patient's psychological aspect. Still I cannot dismiss this phase of the subject without mentioning that a large dose of morphine given just previous to the injection, frequently takes away the patient's interest in the procedure, without inducing toxic symptoms, and thereby negates his being temperamentally unsuited to local anæsthesia. It is also a question in my mind whether one should ever depend upon it alone for the performance of an operation which goes far beyond the ordinary time limits.

### MORPHINE

The margin of safety of morphine and similar drugs is so small that they are never indicated for their general anæsthetic effect. The patient possessing a stable nervous equilibrum does not actually need any sedative if the local anæsthesias be perfectly conducted; however, the delicately balanced individual will gain much comfort from it. The operator must always bear in mind, however, its marked tendency to cause vomiting at most unlooked for and unwished for moments.

We have, in many instances, introduced morphine with the infiltration solution, since during the subsequent operation it exerts its influence at the time it is most needed if employed in this way. Probably too, its toxic influence is lessened because it is more slowly absorbed when used in combination with adrenalin, just as has been shown to be true of novocaine itself.

The dosage of morphine varies greatly with the age and condition of the patient. One-half to one grain is tolerated without undue symptoms by a gall-bladder patient who has had the drug used in many of her attacks. On the other hand, a very small dose may be more than a young child can tolerate without damage. An extreme tolerance is exhibited by patients afflicted with exophthalmic goiter, due I am sure to their rapid oxidation of it. I have used as high as 2 grains at a dose in one such sufferer, who did not even go to sleep nor vomit, although a relatively small dose, viz., 1 grain had acted as an irritant on a previous occasion and caused nausea and vomiting. It requires considerable temerity to mention such doses, and I surely do not wish to be placed in the position of advising them as a routine, still, it goes to show that the subject of morphine dosage offers food for thought. It may be well to remark here that morphine should never be used with local anæsthesia on an ambulatory patient, since it is likely to have a much more temporary debilitating influence than is the local anæsthesia or the minor operation itself.

When, during the progress of an operation, symptoms of approaching morphine intoxication present themselves, as has occasionally happened, we are in the habit of allowing the patient to drink one or more cups of strong, black coffee on the operating table. I am inclined to think that this may have prevented an embarrassing situation in more than one instance.

### THE TECHNIQUE

In general, there is a great deal more to the technique of local anæsthesia than the mere knowledge of how, when, and where to inject. The general care of the patient's psychologic side in the operating room is scarcely second in importance to the local manipulation. It will occur to any one thinking along this line, that none of us possesses the maximum of courage and patience when enduring the pangs of hunger, hence it long ago became customary in our clinic to give the patient his breakfast as usual on the day of operation, provided, of course, no general anæsthesia was to be used.

Mental control should always be attempted by trying to secure the patient's attention, and then engaging him in a discussion of one of his leading interests. These are not usually difficult to ascertain, and in this way the sympathy of the individual is enlisted, also his co-operation often gained. The person who is inclined to balk at the injection may often be rendered amenable to suggestion by the presence of a sympathetic anæsthetist, also by the sight of a gas or ether apparatus, which he is assured is at his command. It is surprising to note how often this little ruse will work; very rarely, however, will the patient take advantage of the opportunity of getting a general anæsthetic, provided the local has been well managed. This line of reasoning has been carried a bit further in certain instances by allowing the patient, after novocaine has been injected, to get the faint *odor* of ether throughout the operation. The satisfied individual will often not differentiate sharply between the odor of ether and an ether anæsthesia, provided, of course, that morphine has been used and the infiltration been adequately made.

Local anæsthesia patients are not to be used as clinic material. Their status can be rendered satisfactory only in a room which is quiet and can on occasion be isolated. There are sensitive individuals who should be blindfolded and have the ears plugged before anything is done, thus guarding the special senses against insult. With each of the sensory nerves guarded against pain stimuli and the mental apparatus protected by morphine the injection may be made anywhere successfully, with the patient interested in music, conversation, the telephone, or reading a book. We often do it in the operating room, if no spectators are present, but our more sensitive patients have this done in bed and are not transported upstairs until they have regained a wanted composure. One should, as a matter of course, never take a patient to the operating room for a form of injection, such as nerve blocking, which necessitates a long wait between the injection and the operation.

I have no doubt, that, for making these injections, we shall some day have special

rooms, decorated appropriately and lending every facility for attracting the sufferer's attention as desired. One who has not done this work may be surprised to know that nothing proves more diverting during infiltration or operation than a few puffs on a cigar or cigarette, a distinct solace to any man who is addicted to the use of nicotine. By the same rule, a drinker must have his normal dose of alcohol before going to the operating room, and I have frequently given him more during the progress of the infiltration or subsequent operation, with excellent effect. Alcohol will for any of us relieve the tedium of any long-seeming experience, such as the stay in an operating room proves to be. The electric fan is one of our valued aids when sympathetic control begins to let go during a tedious procedure; indeed, every patient finds it grateful and most of them will immediately complain if a careless assistant walks between him and the fan.

The injection of itself is by no means the most disagreeable feature of the whole procedure, if gently and properly done, but it is a hard table, an uncomfortable posture, or fatigue that have most to do with wearing out the individual's patience. With this in mind, no really expert manipulator will closely confine the patient until it becomes absolutely necessary to do so, and then will release him at the earliest possible moment. In order to prevent any wait on the table between the injection and the operation, it is a good plan to have all draping of the patient and other preparation of the field done before the infiltration begins. If one employs a nerve block or other form of anæsthesia, requiring an interval of delay before the effect is secured, the initial stage of the procedure should take place before the individual is put on the operating table. It is often an excellent idea after the incision to keep him informed of one's progress, then if he happens to be acutely attentive during the operation, a display of the specimen may interest him to the extent that he will be content during a time-consuming closure, or some other unavoidable but essential formality.

It may not be amiss to deal for a moment with some of the causes of failure in the use of local anæsthesia. In many instances, of course, this is simply a matter of not having the proper solution injected into the right place. On the other hand, the solution may be all right, the injection properly done, and still one of the psychic phases of the subject may be so mishandled as to negate the result.

There are many ways in which the fluid may be improperly prepared. It must not be too old; it must not have been boiled more than once; the adrenalin must not be forgotten and it must never be boiled; also the adrenalin is decomposed if it is added while the solution is very hot; physiological saline must be used as a base for the solution, and the water of which it is made must have been freshly distilled for reasons which are perfectly well known.

It is well before beginning any infiltration to scratch very lightly the intended line of incision. As a result of experience one easily acquires the ability to make a more or less faint red line without scratching deeply enough to cause pain. If one infiltrates a well-marked area it is hardly possible to transgress its limits later and cut, prick, or retract tissues which have their normal sensibility. Many of the operators employ one or more wheals for the introduction of the large needle; I prefer to frost a skin area with Kelene spray, then lift up a furrow and pierce the skin at exactly right angles to its surface with the deep injection needle at once, thus sparing the patient the making of painful wheals.

The length and size of the needle should vary with the work at hand, details of which are readily found in all the works on local anæsthesia. I shall state in passing that the hypodermic syringe and needles have no place in this work because they are entirely too small. I find a 10 to 20 cubic centimeter syringe, with a three-inch twenty-two gauge needle, very useful for the average injection. If the needle is not too sharp or too finely pointed, one can very readily distinguish by feel, after a little practice, the various layers through which he passes it.

The tension on the injected tissues must never be increased too rapidly, nor muscle sheaths be treated at all roughly, since, as above noted, they are extremely sensitive. One who has a due regard for individual peculiarities, who watches the patient, senses his feelings, and pauses as soon as pain is evinced, will succeed in completing an injection which might be impossible in the hands of a rough and unsympathetic operator. It is good practice to infiltrate the deeper tissue layers in a field first, because in this way one acquires a certain amount of anæsthesia in the overlying planes, even before he injects them; then, too, the identification of deeper structures is vastly less difficult before a marked artificial œdema of the superficial layers has been created.

### CIRCULAR BLOCK VS. DIRECT INFILTRATION

It is impossible to make direct comparison between the value of infiltrating an incision line and that of circumscribing it with a barrier of fluid, intended to desensitize the entire area through which the incision is made without getting any fluid into the operative field. There are certain different indications for both procedures, in my mind, although some operators of experience seem unqualifiedly in favor of one or the other extreme for every case. If there are no contra-indications I am inclined to use direct infiltration of the incision line in every hyperæsthetic individual, or when time must be saved for any other reason. This procedure is much the shorter of the two; there is no wait after the injection, also the anæsthesia is more reliable in many cases. There are also a number of local as well as the foregoing general grounds for direct infiltration. If a wound is to be left open, if a fistula is to be created, a drain left behind, or a pack employed, it is difficult to see why a direct infiltration is not as good as any other. If a wound, for any cause is likely to become infected, the simpler procedure is distinctly the better one to use.

Frequently a wide area of the abdominal wall is hypersensitive, as for instance, the region over an inflamed gall-bladder. If for any reason a local anæsthetic is to be used here, it seems logical to make the line of injection as short as possible, hence a direct use of procaine in the incision area is chosen.

On the other hand, I inject a circular barrier in the treatment of malignant diseases. As a matter of course, one should not risk metastases by inserting a needle point into the immediate vicinity of any such lesion. The same method is employed in the treatment of any acutely inflamed area, as for instance, a carbuncle. Direct infiltration of such tissues is just as painful as the incision itself, and at the same time may further increase tension in an acutely inflamed area, something which is very likely to result in opening up new fields to infection.

It is a very easy matter to create a circular barrier around any part of the mid-line of the anterior abdominal wall. This, however, becomes increasingly difficult as we get away from it, hence the indication here seems reasonably clear, *viz.*, to make more and more use of direct infiltration the farther we are from the mid-line. If there is any local reason for not infiltrating directly the lateral abdominal wall I should recommend a paravertebral nerve block rather than a circular barrier.

### NERVE BLOCKING

The epoch marking work of Victor Pauchet should be known to every surgeon who has an interest in regional anæsthesia by nerve blocking. It is not possible to generalize very extensively regarding this division of the subject, since an individual technique for each such operation has, as a matter of course, to be based on more than a passing knowledge of peripheral nerve anatomy. It may be stated in general that the nerve or nerves supplying the region in which an operation is to be performed are injected with 1 or 2 per cent novocaine-adrenalin solution (we find 1 per cent efficacious, although 2 per cent is used by most operators). The desired nerve is identified by the paræsthesia created when a needle point strikes it, or using an insulated needle by the electrical stimulation of a mixed nerve, causing a contraction in the muscles supplied by it. A few cubic centimeters of the above mentioned solution creates a complete anæsthesia in 15

to 30 minutes, which lasts for something like 2 hours.

The different regions of the body are amenable, in the writer's opinion, in different degree to this form of treatment. By way of mentioning a few with which I happen to be somewhat familiar, will say first that the neck, generally speaking, presents a most fertile field for this sort of work. Blocking of the third or fourth cervical nerves at the points where they issue from between the vertebræ, is accomplished with remarkable ease and gives so perfect an anæsthesia over the front and sides of the neck that any operation at all may be accomplished with the utmost satisfaction to the operator and the patient.

Nothing in the whole field of anæsthesia is more satisfactory, for instance, than a thyroidectomy done in this manner. Of course, there is one theoretical risk in making such an injection on both sides of the neck at once, although I have never seen any evidences of it in practice, viz., it is conceivable that one may block and put out of commission both phrenic nerves at one time, thus causing sudden death, a possibility which must be kept in mind.

The major surgery of the chest wall and thoracic contents under regional anæsthesia has not been so satisfactory in my hands as I should like. Minor operations, such as drainage of the pleural cavity, can be very easily done, but even here I believe that an infiltration of the field is simpler, quicker, and in every way more satisfactory. When it is a matter of opening the pleural cavity widely, there are physiological considerations which demand a general anæsthesia. A consideration of them here would lead us too far afield. However, they are fully explained by Sauerbruch in his textbook on thoracic surgery.

I have done a radical breast operation under a combined regional and infiltration procedure, but do not recommend it at all where a patient can take a general anæsthesia. One must block the brachial plexus, practically all of the dorsal nerves, and then create an enormous barrier around the entire field, a procedure which is so difficult and time-consuming as to practically double the surgeon's work, and the patient's load.

In abdominal surgery the question of regional anæsthesia assumes a complexion all its own, which is not encountered elsewhere in the body. My experience leads me to feel that this is the field of all others for the combination of local, regional, and partial general anæsthesia, since we have here to do with cerebrospinal nerves, as well as with sympathetic and vagus as far as the conduction of various pain sensations is concerned.

Nothing is simpler than to get through the abdominal wall with one of the forms of infiltration or nerve blocking. But the parietal peritoneum outside the affected area is extremely sensitive, while traction upon any viscus in the abdomen causes such suffering as to make a patient uncontrollable. (The sympathetic nerves in the various mesenteries always accompany the blood vessels. As is perfectly well known, cutting, crushing, burning, etc., of the abdominal and pelvic viscera cause no pain.)

Packs cannot, in view of what has been said, be withdrawn nor extensive exploration made after a local anæsthesia which may have been sufficient for the opening of the abdominal wall alone. In view of the fact that Victor Pauchet finds it necessary to inject twenty-two dorsal and lumbar nerves in order surely to anæsthetize abdominal wall and contents, for work on both sides of the mid-line, I believe it would be pretty generally admitted that there is no rivalry between local and general anæsthesia for bilateral abdominal operations.

On the other hand, these two forms of anæsthesia surely supplement each other here, as they do nowhere else. It seems, therefore, reasonable and logical, if there be any ground to minimize the quantity of ether, to open the abdomen under local anæsthesia, then later use as much gas or ether as the patient's reaction to pain demands. A general anæsthesia is very quickly induced under such circumstances; there is practically no excitement stage while going under or coming out, and only a superficial degree of ether anæsthesia is required.

A most satisfactory combination is the following, which I may say is the standard

in our clinic when there is any contra-indication to the ordinary quantity of the ether; we give a quarter grain of morphine 30 minutes before the operation, then after the patient is entirely prepared on the table and everything is ready, we begin an ether anæsthesia and the infiltration at the same moment.

By the time the wall is infiltrated and the opening made, the patient has sufficient ether for us to explore, pack off and draw up into the incision the desired viscus, at which point ether is discontinued. This we regard as one of the peaks of the proeedure.

The patient frequently wakes up, but rarely moves during the progress of the manipulation, provided, of course, no pushing or pulling be entailed. He bears now what is termed a normal load under the slight general influence of morphine, novocaine and residual ether, until the second peak is reached, by which is meant, in this instance, the removal of packs, when it is absolutely necessary to give a second small dose of ether. If the anæsthetist is given half a minute's warning, the whole procedure goes smoothly and there is no break in the technique or interruption at any time.

After the packs are out, ether is permanently withdrawn and the abdomen is closed with the patient's co-operation in many instances, and certainly without his opposition at any time, since there is never any of the forced respiration which makes it so difficult at times to approximate the deeper abdominal layers of a patient who is stimulated by ether, or cyanotic from its use, and subconsciously fighting for air. The novocaine infiltration suffices to make the closure absolutely painless.

I have been impressed more than once by the fact that a second operation, a perineorrhaphy for instance, may be done with almost no ether and with no local anæsthesia at all, after one of these abdominal operations under the combined method as described above. Abdominal work in general is better done under combined anæsthesia than under the regional form which involves the blocking of twenty-two spinal nerves; however, certain local fields may be invaded, as for instance, kidney, and biliary passages by the injection of only eight nerves, which is a number well within reason. When one considers that these organs often present a parenchymatous involvement which makes ether dangerous, it seems quite reasonable to operate on patients so afflicted under nerve block.

For the sake of completeness, one may in passing mention visceral anæsthesia secured by injection of the great ganglia and plexus high in the posterior abdomen, though lacking experience with it. It is highly probable that a glance at the anatomy of this region has been sufficient to deter many another investigator, as it has the writer, from attempting pioneer work in this field.

A form of regional anæsthesia which gives us the greatest satisfaction is that secured by the transsacral route. Here we go directly through the ten sacral foramina from behind and block the anterior brachia of the sacral plexus. This enables us to do anything on the viscera in which the gynecologist, urologist, and proctocologist are interested, keeping in mind that the anterior abdominal wall is not affected.

The extremities as one might readily suspect from their anatomical characteristics, furnish the most fertile field of all for the use of nerve blocking. This has been a matter of such common knowledge ever since the epoch-marking experiments of our own Dr. Matas, that a further discussion of it would be superfluous. We doubtless have Dr. Matas to thank for the inspiration which culminated in the invaluable contribution to this department of surgery by his pupil, Dr. Allen.

### SUGGESTIONS EVOLVED FROM AUTHOR'S EXPERIENCE

It occurred to us long ago that a large amount of fluid used in infiltration increases the patient's intake in a very definite manner and without causing discomfort. This reasoning was carried to the extent of gradually increasing the amount of fluid while decreasing the percentage of novocaine from one-half to one-sixteenth, by virtue of which we now administer any desired quantity of fluid

by hypodermoclysis without inducing any real suffering; in fact, the procedure attracts very little attention in many instances.

It is stated in Braun's epoch-marking work on local anæsthesia that the gall-bladder is a forbidden field. It may be worth while to mention in this connection that the writer has repeatedly drained the gall-bladder and removed deeply seated stones without discomfort to the patient, after aspirating the bile and then replacing it with 5 per cent cocaine for a very brief period. This, of course, after a simple infiltration of the abdominal wall.

I have injected the anterior sacral nerves with the abdomen open, under ether, for the performance of second operations on the rectum, anus, and external genitalia. I do not believe it is even necessary to strike the nerves with accuracy, as one gets a fair regional anæsthesia by merely making a massive injection under the soft tissues covering the hollow of the sacrum, thus causing fluid to suffuse everything in the neighborhood of them. One saves a large amount of ether while the abdomen is being closed under infiltration and during the period of preparing a second field for operation on the organs mentioned.

I might by way of repetition stress the plan used so frequently in our clinic of beginning infiltration and ether at the same time, then doing a laparotomy and employing no more ether during the rest of the procedure except when the patient shows unmistakable signs of needing it under peak load.

## CONCLUSIONS

1. It is to be definitely understood that ether by the drop method is the anæsthetic of choice in our clinic for major surgery in general, and local anæsthesia in some form for minor surgery. But we go much further than this; hence an attempt has been made in this address to deal with the large number of special considerations, which do not fall into either one of the above mentioned classes.

2. One must always keep in mind that local anæsthesia has definite limits which are not to be transgressed; I have attempted to make many of them clear.

3. I believe that with increasing experience and better training we shall some day have to establish indications for general anæsthesia rather than for local, as is the common experience today. It will then seem no more reasonable to anæsthetize the entire organism for a strictly local operation on it, than it would at the present time to bind or splint the entire body for an injury to an extremity.

4. Surely no one will advocate the use of local anæsthesia to the point of interfering with the smooth and rapid conduct of a surgical procedure.

5. It may be safely stated that the anæsthetization should never be larger than the operation; for example, one should not under ordinary circumstances attempt a radical breast operation, or it seems to me, any one of the larger abdominal procedures which involve both sides of the mid-line, under local anæsthesia alone.

6. The operator will have to train himself especially for this work if he expects to be successful in it, although in a busy clinic it is unquestionably the correct plan to have one associate who has this phase of surgery wholly in his hands.

7. There is, to my thinking, a very definite field for the local anæsthetist. I am sure that such an individual should play a rôle similar to that which is well known in general anæsthesia. His services ought to be in demand by the surgeon who makes only an occasional use of these methods, or by one who is not temperamentally suited to the acquirement of them.

I have been so fortunate as to profit by the accomplishments of my assistants, Dr. Sam F. Wennerman and Dr. William Murray Winn, to whom I am indebted for most of my local anæsthesias in recent years, to say nothing of much of the enthusiasm which I have acquired for this subject.

# ACUTE PARTIAL ENTEROCELE[1]

By CHARLES F. SAWYER, M.D., F.A.C.S., Chicago

A PARTIAL enterocele is an abdominal hernia in which only a part of the circumference of an intestine projects as a diverticulum through a hernial opening. This will reduce but does not usually completely obliterate the intestinal lumen. Hildanus, in 1598, was the first to mention this finding, but his case was not definite enough to prove that such a condition could occur.

There has been some confusion in nomenclature. By the older writers and by some of the more modern, the disease has been termed "Littre hernia." Littre's description in 1700 was, however, that of a hernia of Meckel's diverticulum and his cases were examples of that condition rather than partial enterocele.

In 1731, LeDrau described the first genuine example of this hernia and in 1757, Louis, in an article on "Gangrenous Hernia," says, "the gut is not always engaged in the ring by a portion large enough to form a loop. Often it is only nipped and that over a surface of varying extent." He thought a spontaneous cure of a fæcal fistula would be proof of the hernia having belonged to this type. His cases were not conclusive.

In 1778, Richter gave us the first really scientific and complete description of the condition and because of this, by many it is now called "Richter's hernia."

Treves, in 1887, was the first to make a comprehensive study of the literature. He collected 50 cases, 4 of which were his own. He remarked that the condition was rare but not a curiosity.

I believe we may now state that it is uncommon rather than rare and of sufficient importance to merit our close study and attention. The available statistics show that it occurs more often in women than men and in adults than in children. It is most frequently femoral and occurs more often in old herniæ that have been reducible. Among the theories advanced as to its mode of formation may be mentioned the following: A loop of intestine may have become adherent over a hernial ring and through increased intra-abdominal and intra-intestinal pressure, a small portion of the bowel has been forced through. Stahl presents an interesting theory based on some case reports of Robinson. He thinks the condition may be due to irregular action of the muscles in the gut wall, or what he terms "disordered peristalsis." He illustrates this by his operative experience with aluminum and glass drainage tubes with holes in their sides. At one time when such an aluminum tube was used, a bud of intestine became strangulated in one of the holes of the tube wall, necessitating a second operation. In another case in which a glass tube was used, a similar intestinal strangulation was relieved only by breaking the tube.

Any part of the bowel may be imprisoned, but the ileum is the portion usually caught. There is usually no confinement of omentum or mesentery. The amount of the circumference of intestinal wall involved varies greatly, but in general it is that farthest from the mesenteric attachment and the line of constriction is circular in outline. The intestine may or may not be adherent within the sac. The same may be said of the continuing intestine outside of the sac. In two of my three cases there were no adhesions, either within or without the sac.

The obstruction to the lumen is naturally variable and upon this point largely depends the wide diversity of the symptoms. The constriction may obstruct the passage of fæces but still allow the passage of gas. As White remarks: "It is possible to have a constriction water tight but not air tight."

The condition of the bowel governs the symptomatology.

In one-third of the cases we find symptoms of the typical strangulated hernia, while in the remainder the symptoms are less severe and ofttimes misleading. The pain may be sudden and sharp, located in the region of the hernia, but it is often diffuse over the abdomen without localization. In two of my

[1] Read before the [illegible] Medical Society, December [illegible], 1911.

cases there was no history of localized pain at hernial site at any time but the colicky-like pain was referred to the epigastrium as in an appendix. The vomiting is less frequent and severe than in most strangulations but it usually occurs. It has very little relation to the constipation and later becomes fæcal in only a small percentage of cases. As regards bowel action, we may have any degree from a diarrhœa to complete stasis. In a large percentage of cases there are bowel movements after the strangulation has occurred. Meteorism is rare because the escape of the gases through the only partially obliterated lumen of the bowel prevents abdominal distention. The hernial protrusion is usually small and may be entirely unnoticed. In Treves series it was neither recognized nor suspected during life in 50 per cent of the cases. In many of the femoral type, there is an enlarged lymphatic gland in front of the femoral opening which may lead to a diagnosis of adenitis. The leucocyte count is of little or no value. The temperature, pulse rate, etc., are as in other strangulations.

The diagnosis is very important but often difficult because of the lack of uniformity in the symptoms. Only by the closest attention to history and the clinical course can we come to a correct conclusion as to the pathological findings.

As to prognosis, it is disappointing in a partial review of the literature to note that we have a mortality of over 50 per cent even in the cases operated upon. This is undoubtedly due to the late diagnosis and to the fact that in many of these cases gangrene occurs earlier than in other strangulated hernia because the constriction is applied directly on the gut without any protection being afforded by the constricted mesentery.

Treatment is operative and immediate; temporizing methods will fail. In most cases efforts at reduction are unjustifiable. The operative risks are far less than those of taxis.

As the bowel may be found in any condition from a mild congestion to a gangrene with perforation, the type of operation will, of course, depend upon the conditions found. In this connection, I wish to commend in certain cases the invagination operation mentioned by Jones, in 1904. Inasmuch as the bud of strangulated intestine is often small, it may be turned back into lumen of bowel by means of suture without vitally interfering with the future patency of the gut. With the patient in collapse, this certainly has an advantage over resection. This is illustrated in one of my cases.

What we may learn from case reports may be of diagnostic value and in turn help lower the alarming mortality of this condition. With this as justification, I wish to report the following three personal cases:

Case 1. Mr. B, a restaurant proprietor, age 32, entered my service at Mercy Hospital at 3 p.m. March 24, 1918, with following history: Five years before he had been operated upon for acute suppurative appendicitis. The wound healed after prolonged drainage, leaving a protrusion at the site of the scar. This bulging varied in size when straining, etc., and was never very tender or painful. Eighteen hours before present admission, he was seized with sudden severe pain referred to epigastrium. Pain was excruciating and there was general abdominal tenderness with localization in a protruding mass in the old scar. The bowels did not move but some gas was expelled. He presented the typical picture of strangulation of a very severe character and was sent at once to the operating room. An incision was made along the outer border of the very tense hernial protrusion. A good sized sac was opened containing dark bloody fluid and a mass of omentum adherent in places to the sac wall. At the neck of the sac, at the side of the small base of this omental mass, there protruded a very dark, plum-colored bud of intestine. When released this was found to be ileum and the constriction had involved about one-half its circumference. There were no adhesions of this particular loop either within or without the sac. Moist heat seemed to produce but little change in the blackened bowel, but because the blood vessel supply in mesentery and proximal half seemed unaffected, the bowel was not resected, but was placed in the abdomen beneath the incision, with a cigarette drain beside it. Adherent omentum was ligated at base and excised together with most of the sac wall and the abdomen closed. He made a very good recovery and has had no trouble since.

I have been unable to find in the literature any case similar to this, viz., an acute partial enterocele in a postoperative hernia.

Case 2. Mr. H., age 80, referred by Dr. Mandel, entered my service at Mercy Hospital, January 9, 1920. He had been suffering acutely for 2 days from abdominal pain and persistent vomiting. His temperature was 97 and general condition poor.

The abdomen was not greatly distended nor tender and no abnormal masses could be felt. He gave a history of having had a right-sided hernia for many years and over the right femoral opening was a protruding mass which seemed like an infected lymph gland. It was not tender and there was no pulsation on coughing. Immediate operation was advised but refused by patient who insisted that his difficulty was stomach trouble, as his pain had all been in mid-abdomen with none at all in region of hernia, and he knew hernia had nothing to do with it.

During the 36 hours following admission, his bowels moved freely, three times, but his condition otherwise became worse and he finally consented to operation. A large infected lymph gland was found in front of a right-sided femoral hernial sac. The sac was distended and contained pus, blood, and fæces. At the femoral opening there was a small intestinal protrusion caught tightly in the ring. At the tip of this protrusion there was a perforation from which escaped fæces. The entire protrusion was grayish black and gangrenous. After enlarging the ring and freeing the loop which was found to be ileum and entirely free of adhesions, it was found the gangrenous portion included about one-fourth the circumference of the bowel. As the adjacent bowel was in good condition, the gangrenous bud was disposed of by inverting it into the lumen by suture. The loop of intestine was placed in the abdomen immediately beneath ring and a small drain inserted. The infected gland and sac were removed and the wound closed. This patient had normal bowel movement the second day after operation and aside from slight infection of wound, made an uneventful recovery, leaving the hospital 27 days after operation. He had no trouble with bowels after recovery.

This patient was remarkable for his energy and initiative, considering his age; e.g., during the night following operation when proctoclysis had been inaugurated and the nurse was not watching, he removed tube from rectum, got out of bed, went to faucet where he drank all the cold water he wished, then got back into bed and reinserted rectal tube as before.

Case 3. Mr. S., age 53, clerk by occupation, entered my service at Mercy Hospital at 11 a.m. October 16, 1920. Three days before admission he began to have severe abdominal pain followed a few hours later by persistent vomiting which on day of admission had become fæcal. Both cathartics and enemas had failed to move bowels. His abdomen was greatly distended and there was general tenderness without localization. He was a typical picture of ileus in a far advanced stage, with subnormal temperature, barely perceptible pulse, cold moist skin, etc. He had had a left inguinal hernia for several years, but examination here failed to reveal either tenderness or tumor.

Operation shortly after admission by median laparotomy below navel. Conditions found were those of acute bowel obstruction with the cause found in the old hernial ring where three-fourths the circumference of a knuckle of small intestine was tightly constricted but not completely strangulated. There were old adhesions holding the loop intestine outside of the sac. The bowel after relieving constriction and adhesions was only a little discolored. A small drain was inserted and the abdomen closed without other attention to hernia. He rallied for few hours but died 12 hours after operation. In this case, although only three-fourths the circumference of bowel was constricted, the obstruction to lumen had been complete.

## SUMMARY

The condition of acute partial enterocele is not so rare as formerly considered and may occur at any abdominal hernial site.

Symptoms are milder than in other strangulations and lack uniformity. The fact that pain is referred to the epigastrium with little or no localization at the hernial site is noteworthy.

The diagnosis must be based on history of old hernia usually, symptoms of strangulation without the constipation in many cases, the lack of abdominal distention, and the small tumor mass or none at all at hernial site.

The prognosis is unfavorable because of late diagnosis and early gangrene of gut.

The treatment is operative at earliest possible moment.

# A COMPARATIVE STUDY OF THE END-RESULTS OF CHOLECYSTOSTOMY AND CHOLECYSTECTOMY[1]

By FRANK D. MOORE, M.D., F.A.C.S., Chicago

WHILE considerable has been written in the past few years concerning the relative values of cholecystostomy and cholecystectomy, it would seem, from the variance of statistics and the many discussions brought forth by each succeeding paper, that the subject is still an open one and that much remains to be said, before any really satisfactory conclusion can be reached.

There has been much discussion as to the *immediate* value of the operations themselves, as to their ease of performance, difficulty of technique, and degree of safety to the patient. As to this point, there is probably but one answer: while cholecystectomy may become, in the hands of the experienced surgeon, a relatively speedy and safe operation, yet it is undeniably true that in the hands of the occasional operator, or in the event of complications or general debility on the part of the patient, cholecystostomy must invariably be the safer operation, the one requiring the minimum both of time and risk to the patient, and at the same time affording also the prospect of immediate and at least temporary relief. We are not to consider, however, that our average surgeon is inexperienced or that he cannot become skillful enough to avoid the dangers that follow upon faulty technique, so that this point we shall not take into consideration at all.

This paper is, then, an attempt to compare not the immediate relief afforded the patient, nor the ease and safety of operation, but the *end-results*, the factors which will make for the well-being and health of the patient years after operation. He may, it is true, be much benefited for a time or may even have complete relief following either of these operations, but in which case is he more likely to obtain permanent relief from his trouble and in which is he going to return to us in a few months or years with the same complaint for which the first operation was performed? It is, then, the condition of the patient, as many years as possible after operation, which we wish to study and from which we can draw our most satisfactory conclusions.

Formerly, and, in fact, until about the past four or five years, cholecystostomy was considered by most surgeons to be the operation of choice in practically all cases of chronic cholecystitis, stones in the gall-bladder, acute inflammatory conditions and anything short of malignancy. It was done, in most cases, partly because the immediate relief afforded seemed to be a fully adequate reason for its performance and partly because many operators did not, according to their own reports, realize the comparative speed and safety with which, with experience and improved technique, a total removal of the gall-bladder could be performed. Many writers whose articles have been published during the last two or three years, have discussed their results, with the modifying statement, that formerly they performed drainage operations upon nearly all of their gall-bladder cases in preference to the now more popular excision. There have, however, been some exceptions to these views, a few surgeons stating that there seemed to be as many recurrences following their cases of removal as of drainage.

In studying the actual statistics not only the author's own series of cases were reviewed, but a number of series given in detail in the literature of the past three years. The total number of cases cited were about three thousand, with a second report on about two hundred and fifty made several years after operation. These figures, of course, comprise those given by a number of operators, and the result and deductions, therefore, must, of course, be only approximate, but a fair perspective can thereby be obtained and a number of working principles be evolved.

These series were studied with an effort to discover several things:

[1] Read before the Chicago Surgical Society, January 7, 1921 (For discussion, see p. 8[illegible]

1. The relative number of recurrences of symptoms in the case of cholecystostomy and cholecystectomy.

2. The type of symptom most liable to follow operation.

3. The etiological conditions which most frequently permit the recurrence of symptoms, together with the type of operation preceding the pathology.

4. The relative period of freedom from symptoms following each of the two types of operation under discussion.

5. The relative mortality.

6. The immediate pathological result, if any.

As to the relative frequency of recurrence of symptoms in the two types of operation here discussed, that is, total removal and drainage of the gall-bladder, results in the total number of cases studied were tabulated as follows: secondary operations following cholecystectomy 57; cholecystostomy 89. Average period of relief following cholecystectomy 2½ years; cholecystostomy 8 to 9 months. Average condition of patient 3 to 10 years after operation, classified as good, fair or bad, cholecystectomy 70 per cent good, 20 per cent fair, 10 per cent bad; cholecystostomy 40 per cent good, 45 per cent fair, 5 per cent bad. Average mortality: cholecystectomy and cholecystostomy, approximately 5 per cent.

Pathological conditions found most frequently during secondary operations following cholecystectomy were dilatation of ducts; adhesions; stones; stricture of common or cystic duct, due to trauma; pancreatitis: following cholecystostomy, stones in bladder or ducts; chronic cholecystitis; adhesions; fistula; stricture of ducts or of ampulla of Vater; cholecystitis; obstruction of the pylorus.

These show that the majority of recurrences following cholecystectomy are mechanical and due largely to errors in technique, undue trauma, etc. They can, therefore, be largely avoided. The recurrences following drainage are, on the other hand, largely due to primary pathology and as such, can only be prevented by a removal of the original cause. Deaver stated that 65 per cent of his recurrences could have been prevented by removal.

From these approximate results, certain deductions can be drawn, as at least, working principles:

1. There is no evidence that a total extirpation of the gall-bladder results in any serious or permanent impairment of body function or metabolism. Indeed, numbers of cases apparently enjoy the best of health for many years following cholecystectomy, while the flow of bile into the duodenum becomes constant instead of intermittent. The dilatation of the common duct probably acts as a partially compensatory measure and the system apparently adapts itself readily to the new schedule of operation. Certainly, we often find more interference with intestinal digestion during prolonged drainage in which the bile is almost entirely passed off outside the duodenum, as many cases seem unable to tolerate this absence of bile in the duodenal contents. The question is also raised as to its effect on the pancreatic function, due to the lack of biliary stimulation on that organ.

2. As to the type of symptom recurring most frequently after operation, the majority of patients reported pain of the typical gallstone type, together with flatulence, nausea, and vomiting; jaundice, considerably less frequent. These symptoms are not to be distinguished from the type of complaint with which the patient comes, primarily, under observation, so that it can safely be assumed, in cases of drainage at least, that the cause which produced the original trouble is generally the cause of recurrence; that is, that the symptoms have been temporarily relieved, while the original cause of the disturbance, the real seat of pathology, has not been touched at all. This cause is generally in such cases, the presence of chronic cholecystitis, with or without accompanying stones. In cases of removal, however, outside of adhesions, the cause of recurring symptoms must be laid to the door of stones in the common or cystic ducts, dilatation of the ducts consequent upon removal of the bladder, chronic pancreatitis or one of the other possible complications.

3. As to the type of pathological condition which most frequently permits the recurrence of these various symptoms, only one recent series of cases found in the literature gave de-

tailed figures. Deaver and Reimainn in a series of 70 cases of secondary operation, give a record of the pathological conditions found at the second operation, as follows: Adhesions were the most frequent pathological condition found, occurring in 39 cases, or 52 per cent. Stone in the gall-bladder or ducts was found in 26 cases. Other pathological conditions were: cholecystitis, fistula, obstruction of the common duct, chronic pancreatitis, pancreatitic lymphangitis, pyloric obstruction and stricture of a duct or of the ampulla of Vater. These were about the same conditions noted in other reports as well as in the author's own series.

In the case of adhesions, the worst ones, it is true, were those found following cholecystectomies, but this must also be considered in view of the fact that a total removal of the gall-bladder requires, of necessity, considerable more trauma to surrounding tissues than a mere opening and drainage of the bladder, without an attempt at removal; also that many cholecystectomies were secondary to a previous cholecystostomy.

Stones were the next most frequent cause of recurrence of symptoms and these were by far more common in cases of primary drainage. In many cases they may have been mere sandy material, overlooked at the first operation and later developed to a size which produced symptoms. As to how many of the stones found in secondary operations have been formed entirely within the intervening period, it is impossible to say, and in this connection it is probably wise to emphasize the importance of making, during cholecystectomy, a thorough examination of the common duct as to the possible presence of stones.

Chronic cholecystitis was the third most frequent cause of recurrence and occurs, of course, only after drainage cases, most of which had primary operations, for the relief of symptoms only, that relief disappearing as soon as the temporary drainage established by operation had disappeared. In this class of cases, where symptoms have gone on usually for years before the patient comes under observation, and where often at operation the gall-bladder is found to be atrophic and practically functionless, there is surely the strongest indication for a total removal of the long-offending seat of infection.

Out of a series of 51 cases of secondary operation, 36 were found to have followed primary cholecystostomy and 15 cholecystectomy. In other series, results varied widely, but in the total tabulation, many more secondary operations followed drainage than excision. In some of these cases, also, more than one drainage had been performed before removal was attempted.

The relative period of freedom from symptoms varied in drainage cases, from a few months to nine or ten years, with an average approximate interval of two or three years. In cases of removal the period of freedom from symptoms was much shorter, usually recurrences coming on if at all within the first one to two years, but this is offset by the fact that more cases of removal remained entirely free from symptoms for an indefinite period or as long after operation as it was possible to trace the patient.

The relative mortality of the two operations was found to be approximately the same, that is, about 5 per cent. This is probably made so by the fact that while cholecystectomy, in itself, is of greater immediate risk to the patient, cholecystostomy is performed in a number of cases in which the previous condition is such as to make him a very poor operative risk, although necessitating operative interference.

Immediate pathological results of removal of the gall-bladder are, first of all, the dilatation of the ducts, which occurs probably in compensation for the loss of the gall-bladder. This is a condition also found following atrophy and loss of function of the gall-bladder and is usually associated with any long-continued chronic cholecystitis. It may then be regarded, when found following removal of the bladder, not so much in the light of a pathological condition, as a normal compensatory affair, much as we regard the establishment of a collateral circulation when the original channel of circulation has been blocked off.

Another pathological condition, coming on fairly soon after operation, is one which may follow either cholecystostomy or cholecys-

tectomy—the formation of adhesions, with the possible binding down of the omentum or duodenum or adhesions of the hepatic flexure to the liver. These adhesions, however, cannot be regarded as a mere development due to operation alone, as the degree of skill employed in the technique of operation makes a great difference in this particular sequel.

*Functional derangements* sometimes occur, following drainage cases, due to the fact that the intestines do not tolerate well the absence of bile from their contents. This occurs also in any case of postoperative stricture or obstruction of the common duct.

*Pancreatitis* may follow traumatism in operation but is a rare sequel.

*Hernias* are more frequent after cholecystostomies than after cholecystectomies, due to the much larger opening left in the abdominal wall, the slowness of the healing process and the infection of the incision which frequently follows prolonged drainage. It has been found to occur twice as often and to a much greater degree in the latter type of operation.

SUMMARY

We may, then, summarize the end-results of cholecystectomy as compared with those of cholecystostomy, as follows:

In general, cholecystectomy is the operation of choice in all cases, except where general debility, serious complications such as abcess, peritonitis or previous extensive adhesions make removal too dangerous or prolonged an operation. In these cases, cholecystostomy with possible later cholecystectomy, may be done with advantage.

It has been proved by numbers of cases and observations by various authors, that a removal of the gall-bladder is not, in itself, detrimental to the future health and well-being of the patient. Why, then, permit the patient to face the risk, not only of possible, but of probable recurrence of trouble, with the necessity of a future second and more difficult operation, when in the hands of a careful surgeon, a total removal of the offending organ may be done with but slightly greater expenditure of time and with but little more immediate risk to the patient?

Judgment in the selection of cases for removal, early diagnosis and early operation, all make for the choice and ultimately vastly more satisfactory results of cholecystectomy.

The value of this method of treatment for appendicitis is unquestioned, and it seems as logical to follow this same procedure in the case of a similarly affected gall-bladder. A diseased appendix is obviously of no use and is manifestly a source of danger. Is not a functionless and diseased gall-bladder to be regarded in the same light?

The diseased gall-bladder has also come much into the limelight, of recent years, as a focus of infection for various forms of arthritis, anæmias and general constitutional disturbances, and many removals of the gall-bladder have been followed by marked improvement in the general bodily metabolism and welfare.

It would seem, then, that cholecystostomy may well be regarded only as a makeshift or temporary resort, where conditions are such as to contra-indicate the performance of a truly remedial operation, and that cholecystectomy may be accepted as the operation of general choice.

# RESULTS IN OPEN TREATMENT OF FRACTURES[1]

By JOSEPH F. SMITH, M.D., F.A.C.S., Wausau, Wisconsin

IN this brief report of results obtained by the open treatment of fracture it is not our purpose to discuss the relative merits of the open and closed methods of treatment, nor the advantages and disadvantages of the various operations that have been proposed, nor of the different devices that have been developed by those who have advocated open treatment. It is our purpose to summarize briefly our methods and results in a group of 97 fractures in which we have employed open treatment in one form or another.

It has been our custom to treat by the open method only those cases in which, in our judgment, it was impossible to *secure* and *maintain* satisfactory approximation by the older methods. It is recognized that there exists a wide difference of opinion as to what should be regarded as satisfactory approximation. End-to-end apposition of one-half to two-thirds of the fractured surface, with good alignment and without rotation deformity we have regarded as satisfactory without recourse to open methods. In cases in which these conditions could not be secured and maintained we have employed open treatment unless there existed general or local conditions which contra-indicated operative measures.

## METHODS EMPLOYED

We have endeavored to employ in each individual case that means of fixation which seemed easiest of application in the particular condition presented, provided it sufficed to secure and maintain a satisfactory reduction until the proper fixation dressing of plaster or splints could be applied. Plaster casts, with windows cut out for after-care of the wound, have been the means of fixation most frequently employed. Where plates or bands have been used it has generally been our custom to re-open the wound under local anæsthesia and remove the plate about two or three weeks before removal of the fixation dressing so as to allow time for the wound to heal before the patient's discharge. In open operations, particularly on the long bones, we have been impressed by the frequency with which strands of muscle, fascia, or periosteum have been found impacted between the ends of the fragments, often in such a location as to render entirely impossible anything like complete reduction by indirect methods.

## AFTER-CARE

Patients who have had fractures treated by the open method should be given massage and active and passive motion after removal of the fixation dressings in exactly the same manner as patients treated by the closed method. The joints should receive early attention in order to avoid ankylosis, stiffness, and prolonged disability.

In a series of 97 cases treated by open method the bones affected were:

| | Cases | | Cases |
|---|---|---|---|
| Femur | 26 | Lower jaw | 2 |
| Fibia | 14 | Upper jaw | 1 |
| Humerus | 11 | Patella | 6 |
| Tibia and fibula | 12 | Carpal bones | 2 |
| Fibula | 1 | Metacarpal bones | 2 |
| Radius | 5 | Metatarsal bones | 1 |
| Ulna | 1 | Olecranon | 2 |
| Radius and ulna | 6 | Both radii and both ulnæ | 1 |
| Clavicle | 4 | | |

The means of fixation employed were:

| | Cases |
|---|---|
| Lane plate | 38 |
| Intramedullary graft | 2 |
| Bone graft (sliding) | 4 |
| Bone screws or bone pegs | 5 |
| Silver wire | 33 |
| Kangaroo tendon | 1 |
| Parham-Martin band | 1 |
| Open reduction, no fixation device | 9 |
| Excision of fragment | 3 |
| Steel nails or screws | 6 |

We have encountered the following complications:

| | Cases |
|---|---|
| Infection (simple fractures) | 2 |
| Infection (compound fractures) | 12 |
| Failure of union | 1 |
| Delayed union | 3 |
| Infection, failure of union—amputation (compound fracture) | 1 |
| Bone graft lost by infection, later union | 1 |
| Refracture by fall after removal of cast | 2 |

[1] Read before the Chicago Surgical Society, December 3, 1919. For discussion, see page 51.

Infection occurred in two cases of simple fracture which were subjected to open operation. In the first one of these, the fracture consisted of a comminuted fracture of the femur with several large loose fragments. The patient's condition was extremely bad on account of shock and exposure. The operation in this case consisted of simple circular wiring of the ends of two of the fragments with silver wire. Notwithstanding the very simple procedure a very severe infection ensued, which resulted in a long-standing osteomyelitis.

The second case was one with comminuted fracture of both bones of the leg in an elderly man due to an explosion of dynamite. In this case there was extensive comminution of both the tibia and fibula with considerable bruising of the surrounding tissues. The operation carried out in this case consisted of a sliding bone graft, which was done about 4 or 5 days after the injury. Evidently the injury to the surrounding tissues made conditions unfavorable for open operation; infection followed with loss of the graft and a long-standing osteomyelitis which required several months to clear up.

In both these cases healing finally occurred with union. In a few of the other cases there have been slight superficial infections which cleared up without any osteomyelitis after removal of the fixation device.

It has been our impression that the preservation of the periosteum is very important in open operation, especially on the long bones; that in no case should the periosteum be stripped or scraped from the bone in applying the fixation device. In using the Lane plate we are very careful to preserve the periosteum, applying the plate outside the periosteum and after the screws have been turned down securely, they are given a half turn backward, in order to prevent harmful pressure necrosis on the bone and periosteum.

# PRIMARY SCLEROMA OF THE LARYNX IN A NEGRO BORN IN MARYLAND

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From the Departments of Surgery and Pathology of the Johns Hopkins University and Hospital

SCLEROMA of the upper respiratory tract is a very rare disease in this country. A few cases have been reported but all that are authentic have occurred in immigrants from Europe (1, 2, 3, 4). Only two cases have been encountered in some one and a half million patients treated in the wards and out-patient department of the Johns Hopkins Hospital during the past 30 years: one was in an immigrant who had been treated in Berlin before coming to America; the other, which is recorded in detail below, is, so far as we can learn, the first case observed in a native of the United States. The patient was a negro, born in Baltimore, who had not been out of this country, except to the West Indies and Central American countries, where he went as a fireman on a ship that plied between Baltimore and southern ports.

The following is an abstract from the hospital records of the case (Surg. No. 42,107).

R. C., colored male, born in the United States; age 23; laborer and sometimes marine fireman. Admitted March 12; died March 18, 1917.

There was nothing of interest in the family or personal history except an admission of an attack of gonorrhœa 6 years before, and a denial of lues.

*Present illness.* According to the patient, on one occasion, 3 years before, he had suffered from an attack of "short windedness" which lasted for about 12 hours. He had no pain or difficulty in swallowing but complained of a sense of tightness over the upper central part of the chest. He experienced no more trouble until 6 months later when he had two attacks in 4 days, each lasting through the forenoon. Three weeks before admission (the patient says) he was in St. Augustine, Florida, and caught a severe cold. That night he began to have difficulty in breathing which gradually became worse. He returned to Baltimore on March 5, and after a night of severe dyspnœa, walked to the hospital. He complained of having something in his throat that "needs to be raised." He had no pain or difficulty in swallowing. The patient's sister thought that he had lost about 40 pounds in the last 3 or 4 years.

On admission, he was found to be suffering from marked inspiratory dyspnœa so that he had to sit up in bed. He was expectorating large amounts of thick tenacious sputum. The temperature was 101.5° F.; pulse 110; respiration 38.

The routine physical examination which included the ears, nose, mouth and pharynx revealed nothing of importance. Over the front of the chest the breathing had a tubular quality but there were no râles. Examination of the larynx at this time was unsatisfactory. We felt that we were probably dealing with a case of gummatous infiltration of the larynx and trachea, and we accordingly gave the patient mercurial inunctions and potassium iodide by mouth. The treatment, however, seemed to make him worse and it was soon discontinued despite the fact that the Wassermann test gave a 4+ reaction. During his stay in the hospital the temperature ranged from 101.5° to 98°; it was usually below 100°. His condition was, apparently, improving until the day of his death (March 18), when the following notes were recorded:

A good view of the larynx was today obtained for the first time. There was nothing abnormal above the cords, except slight œdema of the arytenoids. The false and true cords were easily seen. Œdematous red tissue was seen below the cords which was evidently producing the obstruction.

The patient has been having increasingly difficult respirations this afternoon and evening. At 7 p.m. he was sitting up in bed because of labored breathing; and during inspiration made a hoarse, wheezing, crowing noise. Occasionally he coughed. He was given 8 minims of adrenalin hypodermatically.

At about 9 o'clock the patient was much more comfortable, the respirations had dropped to 26 per minute and were somewhat less labored. At 10:25 they suddenly became much slower (6 per minute) and he died before the house officer could get to the ward.

Autopsy (No. 5068) made at 2 p.m., March 19, 1917, by Dr. William P. Finney, Jr. (only the positive findings of the autopsy record are here quoted):

There are one or two quite large glands at the bifurcation of the trachea, but there are no enlarged mediastinal glands. On opening the trachea from below upward nothing of interest is encountered until the lower level of the isthmus of the thyroid gland is reached. At this point the mucous membrane of the trachea begins to become thickened and there is a gradually increasing stenosis, until finally at the level of the vocal cords there is an almost complete occlusion (Fig. 1). The obstruction is seen to be due to a thickening of the mucous membrane which is grayish-white in color, has a rather granular

appearance, and is overlaid with a small amount of mucopurulent material. On the surface of the mucous membrane there are a few white papillomatous bead-like masses, only 2 to 3 millimeters in diameter and emerging about the same distance above the surface. Above the vocal cords there is no change in the mucous membrane except in the region of the anterior commissure. Nowhere does there seem to be any deep ulceration of the mucous membranes, but the surface here and there gives the appearance of being superficially ulcerated. There are several puckerings in the arch of the aorta, at the base of the aortic valves, and in the abdominal aorta, especially above the bifurcation.

*Microscopical notes on the larynx.* Sections taken through the mucosa and cartilaginous rings of the upper trachea and larynx show that the pathological changes extend from 1 centimeter above the vocal cords to the lower border of the isthmus of the thyroid gland.

*The chief histological features are the following* (Figs. 2, 3, 4, 5 and 6).

1. All ciliated epithelium is replaced with squamous epithelium.

2. The submucous infiltration consists of small round cells and plasma cells. There are no polymorphonuclear leucocytes present. The blood-vessels are not congested and there is no hæmorrhage. An occasional mucous gland is seen. The lymph spaces are slightly enlarged and more prominent than usual.

3. In this infiltrated area are seen large numbers of small spherical bodies (the hyaline bodies of Unna). These stain well with practically all the aniline dyes. With eosin they stain very lightly and with Van Gieson's stain, bright yellow. With methyl violet, gentian violet, methyl blue and fuchsin, they stain deeply the color of the dye. These bodies occur sometimes singly, sometimes in pairs, sometimes in clusters of four or more. Singly or in pairs they are quite large and have a diameter about five times that of a red blood cell. When occurring in clusters some are large and some quite small. A nucleus is seen in many of these hyaline bodies.

4. There are a large number of swollen pale cells, the so-called Mikulicz cells which have been well described as "lace," "foam," or "bubble" cells. They have a nucleus similar to that of a small round cell or plasma cell. The cell outline has a diameter 10 or 15 times as great as that of an ordinary plasma cell. The cytoplasm does not stain at all but running through the cell body are fine reticular lines. These give the characteristic appearance as if a number of tiny soap bubbles were cut in cross-section.

5. Within these Mikulicz cells or in the spaces which they usually occupy just beneath the epithelium may be seen short, thick bacilli. These do not stain readily but are stained well with aqueous methyl violet if they are left in the stain 1 or 2 days, and not decolorized too much in alcohol.

The section of one of the puckered scars in the aorta shows a destruction of the elastic fibers of the media characteristic of a syphilitic mesaortitis.

From the above description and the accompanying microphotographs there can be no doubt that this patient had a scleroma of the larynx and trachea with no involvement of the nasal mucous membrane. This man was a native of Baltimore but his occupation as fireman on a ship had taken him to the West Indies and Central America. He had never been in Europe.

If the true nature of the malady had been recognized and a low tracheotomy performed soon after admission to the hospital, his life would, probably, have been prolonged for several years. The clinical diagnosis, however, was syphilis of the larynx and trachea, and until a few hours before death his condition had, apparently, been much improved by simple rest in bed. The true nature of the disease was recognized only when the microscopical sections from the mucous membrane of the larynx and trachea were studied.

The autopsy disclosed syphilitic lesions of the aorta, but this was entirely independent of the lesion in the larynx and trachea.

### HISTORY OF SCLEROMA

In view of the fact that American physicians are unfamiliar with scleroma, the following brief description may be of interest.

The disease was first described in 1870 by Hebra (5), who named it *Rhinosklerom*, because the nasal passages are often primarily involved. It is endemic in Austria, Poland, Galicia, East Prussia, and Southern Italy. Sporadic cases have been reported from several other countries. Some authorities think that it was brought to Europe from Asia (6).

*Etiology and incidence.* The etiological agent in scleroma has not been definitely determined. In 1882 von Frisch (7), for the first time, isolated in pure culture from scleroma nodules a bacillus which he considered to be the cause of the disease and which, therefore, he named the *Rhinosklerom* bacillus. It appears as a very short rod and has a capsule; it grows on ordinary media and stains easily. This bacillus, which is always to be found in the oldest lesions and in stained

sections, is seen chiefly in the Mikulicz cells. Other workers also have isolated the same bacillus from lesions of scleroma, but no one has succeeded in reproducing the disease in animals. Von Frisch failed to do so in dogs, rabbits, and guinea-pigs, using a pure culture of the bacilli, lymph from the tissue, or a piece of the diseased tissue. Many others have tried, employing various animals, but all have failed (8).

The failure to produce the disease and the fact that the rhinoscleroma bacillus closely resembles the bacillus Friedlaender, bacillus mucosus capsulatus and bacillus ozenæ have led several authors to question its specificity. Babès (9) found the von Frisch bacillus in about 50 per cent of cases of chronic inflammation of the nasal mucous membrane, and he and Perkins (10) claim that it cannot be distinguished from the Friedlaender bacillus. Neumann (11) found organisms similar to the von Frisch, Friedlaender and ozena bacilli in the nasal cavities of 20 per cent of normal persons. On the other hand, Brunner (12) isolated the von Frisch bacillus in 30 consecutive cases of rhinoscleroma, and he claims that by serological tests it can be distinguished from the other organisms of the same group. Bailey (13) also believes that the rhinoscleroma bacillus can be distinguished from all other bacilli by means of its cultural characteristics and immunological reactions.

The mode of spread is not known, but some authors consider it contagious and recommend that these patients be isolated (14 and 15). It occurs chiefly in small villages where the living conditions are very unhygienic.

The incubation period is not known because of the insidiousness of the onset. Children as well as adults may be attacked.

*Pathological anatomy.* At first Hebra (16) thought that the condition represented a new-growth, because of the microscopical appearances. In 1872, Gerber (17) after a microscopical study concluded that it was due to a chronic inflammatory process, and since then this has been the prevailing opinion. Scleroma most often begins in the anterior portion of the nasal mucous membrane, but it may appear primarily anywhere in the upper respiratory passages. It may also start on the skin of the upper lip or the vestibule of the nose, but tends to spread very slowly in the mucous membrane. The lacrimal ducts, the Eustachian tubes, the nasopharynx, the oropharynx, the soft and hard palates, the larynx, trachea, and bronchi may become involved. In the larynx it usually begins just below the vocal cords.

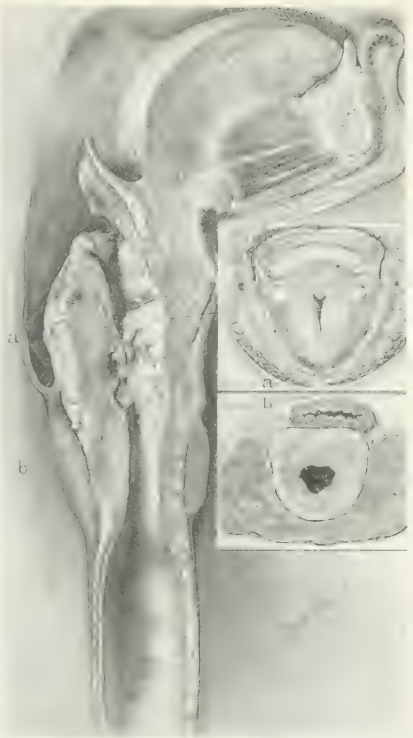


Fig. 1. Autopsy 50/18. Scleroma of the larynx. The longitudinal section shows the extent of the process. The cross-sections show the size of the lumen. *a*, At the level of the vocal cords; *b*, at the level of the isthmus of the thyroid.

The lesions are usually bilateral. In the beginning they appear as small, soft, œdematous, bluish-red nodules which have well defined edges. Later these nodules deeply infiltrate the mucous membrane, become

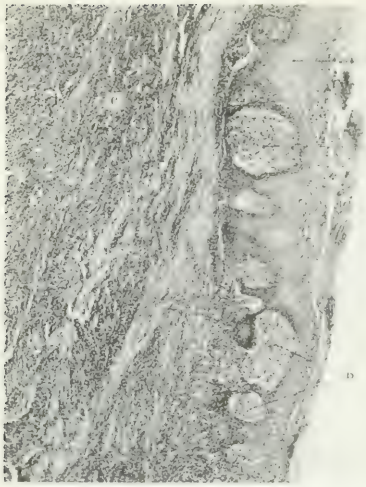

Fig. 2. A section of the mucous membrane of the trachea at the level of the thyroid gland. *a*, The ciliated epithelium has been replaced with squamous cells; *b*, areas composed almost entirely of Mikulicz cells; *c*, the round-cell infiltration and strands of scar tissue which have entirely destroyed all normal elements of the mucous membrane.

grayish in color and very hard, even showing calcified areas. They do not ulcerate, except as a result of trauma and when the skin is involved. The disease does not destroy underlying bone and cartilage. The neighboring lymph glands are practically never involved.

According to the microscopical appearances, the scleroma lesion begins around the blood and lymph vessels in the adventitial layer of the mucous membrane, and is thought to spread by way of these vessels. At first the vessels become dilated and then small round and plasma cells accumulate in large numbers around them. This causes the œdema and the early appearance of the nodules. There is also a great increase in the elastic and connective tissue. Later, the walls of the blood and lymph vessels become obliterated by the connective tissue and the cellular elements die. The softness is now lost, except where the lesion is spreading, and the mucous membrane of the original focus becomes replaced by connective tissue. The epithelium may or may not be affected, but when it is implicated, the ciliated cells are converted into thick layers of stratified squamous cells, and eventually the normal structure of the mucous membrane is destroyed. In the skin, the sweat and sebaceous glands are destroyed and the hairs are lost.

The most characteristic microscopical finding in scleroma is the large cell with vacuolated and poorly staining protoplasm which is known as the "Mikulicz," "foam," or "lace" cell. It was first described by Mikulicz (18) in 1877, whose publication on scleroma is among the best. These cells vary in size but, when typical, have a diameter from 15 to 20 times as large as that of a red blood corpuscle, and usually contain one or more nuclei. The foamy, reticulated appearance of the protoplasm has been attributed to the mucus elaborated by the rhinoscleroma bacillus, which is present in large numbers within them. They are most numerous in the oldest lesions and are most often seen just under the epithelium. Mikulicz cells are thought to be

Fig. 3. A section of the mucous membrane of the larynx below the vocal cords. *a*, A thick layer of squamous cells has replaced the ciliated epithelium; *b*, epithelial pearls closely resembling those seen in squamous cell carcinoma; the cellular infiltration. The predominating types of cells are: mononuclears, Mikulicz cells, and spindle cells.

a degeneration or hydropsic form of large mononuclear leucocytes.

Another characteristic of scleroma is found in the homogeneous, round masses of hyaline-like material, which are scattered throughout the tissue. These bodies, first described by Unna (19), have a diameter from 3 to 5 times that of a red blood corpuscle and stain intensively with all of the acid dyes. Some authors think that they have a nucleus; others, that they have not. Their origin has been ascribed to degenerated red blood corpuscles. Another explanation is that they represent the end-stage of the Mikulicz cells and that their protoplasm and the bacilli within them are changed into hyaline.

*Symptomatology.* The clinical course of scleroma is very slow; some cases last from 20 to 30 years. The first symptoms are apt to be nasal obstruction, repeated epistaxis or deformity of the external nose and upper lip. The skin, when involved, becomes dry, cracked, and ulcerated. Later, as the disease spreads to other parts of the upper respiratory tract, other regional symptoms appear. In the larynx the disease, as a rule, begins below the vocal cords and extends upward or downward. The symptoms are hoarseness, a metallic cough and dyspnœa. The last may become so marked as to require a tracheotomy.

Fig. 4. A section from the larynx below the cords that shows: *a*. Dense scar tissue of this type replaces all cellular elements in the end-stage of the disease; *b*, the intrinsic muscles of the larynx surrounded with scar tissue and round cells (c).

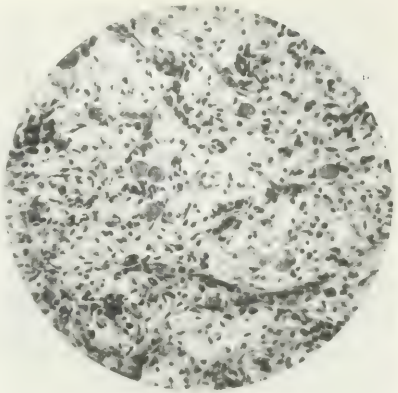

Fig. 5. *a*. The hyaline bodies of Unna; *b*, the "foam cells" of Mikulicz.

The presence of these two types of cells together with the demonstration of organisms in the Mikulicz cells (Fig. 6) establishes the microscopical diagnosis of rhinoscleroma.

The lesions are very hard but not painful, except slightly to the touch. Sometimes when the disease is well advanced there is contraction and deformity.

Scleroma does not prove fatal, except when the larynx, trachea, or bronchi are so much involved that suffocation ensues.

*Diagnosis.* Scleroma may at times be confused with tertiary syphilis, leprosy, lupus, sarcoma or carcinoma, any of which it may closely resemble. Clinically, the points in favor of scleroma are: marked chronicity, absence of tissue destruction and of pain, an ivory hardness of the lesions, and the European nationality of patient. A certain diagnosis, however, cannot be made without a microscopical study of a piece of the diseased tissue.

*Treatment.* All forms of treatment are almost valueless in the end-stage of this dis-

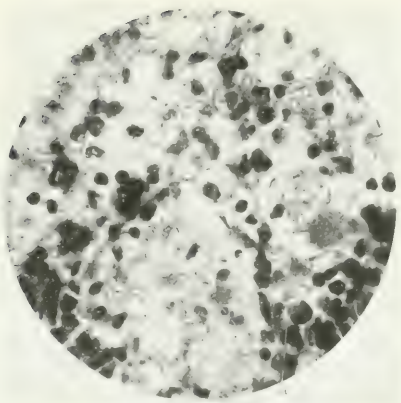

Fig. 6. An oil immersion view of one of the nests of Mikulicz cells shown in Figure 2. Note the large number of bacteria in these cells.

ease. When the trachea is involved, however, the dyspnœa may be temporarily relieved by repeated curettage and dilatations. In the early stage the X-ray and radium have been used with more success than any other agents. Some cases have greatly improved and a few "cures" (20) have been reported. Brunner and Jakubowsky (21), in 1915, reviewed the results of treatment with mercury, arsenic, iodine, salvarsan, tuberculin, the local applications of caustics and the actual cautery, and concluded that all of them are of no value. They found that vaccine therapy was useful in treating the early stages and that it prevented the disease from spreading, but that it was useless in removing the older sclerotic areas.

In conclusion I wish to acknowledge my indebtedness to Clinical Professor S. J. Crowe, Department of Surgery, Johns Hopkins University, for assistance in several ways in the preparation of this paper. Also, I wish to thank Professor Halsted and Professor MacCallum for the privilege of reporting this case.

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# THE SUPPORTS OF THE UTERUS[1]

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Gynecologist to the Perth Hospital; Vice-President, Section of Gynecology and Obstetrics, Australasian Medical Congress, 192

## PROPOSITIONS

In a paper contributed to the Australasian Medical Congress of 1908 I submitted two propositions: (1) that the primary supports of the uterus are its ligaments; and (2) that the secondary support is the pelvic diaphragm, which tends to prevent undue stretching of the ligaments under the influence of intra-abdominal strain.

## SECONDARY SUPPORT

If a normal woman under anæsthesia and in the lithotomy position vomits, the vagina being widely opened up by a speculum practically to put the pelvic diaphragm out of commission, the uterus is driven down the vagina during the effort of vomiting, and retreats to its original position when the effort ceases. If the speculum be replaced by a finger, then with each expulsive effort the levatores ani are felt to contract on to the finger and up to the uterus, rectum, and bladder as these organs are driven down toward the pelvic diaphragm. Furthermore, in cases sometimes encountered, without the slightest uterine prolapse, but with a torn pelvic diaphragm involving the *sphincter ani* and bowel (complete laceration of the perineum), similar effects are noted with the speculum, but diminished effectiveness of the pelvic diaphragm with the finger. To these experimental facts it may be added that procidentia uteri may occur with a perfectly normal pelvic diaphragm, and that uterine prolapse has been cured by shortening the strong structures at the base of the broad ligament (passing out from each side of the uterus and vagina) in cases where patients have refused operation on an accompanying torn pelvic diaphragm.

It would appear, then, that the pelvic diaphragm plays only a secondary part as a support of the uterus, and that other structures, strong and elastic, play the main part in holding the uterus in the pelvis, and are thus the primary supports of the uterus. With inefficient primary supports, a normal pelvic diaphragm does not prevent uterine prolapse; with normal primary supports, an inefficient pelvic diaphragm does not cause uterine prolapse.

## PRIMARY SUPPORTS

The possible primary supports of the uterus are: (1) the mass of tissue at the base of the broad ligament extending outward on each side from the uterus and vaginal fornix (cardinal ligament of Kochs, transverse ligament of Mackenrodt); and (2) the utero-sacral ligaments.

*Cardinal ligaments.* Clarence Webster states that within the peritoneal covering of the broad ligaments "are fibromuscular and elastic tissues, which can be traced as bands in several places running from the uterus to the pelvic wall. The upper part of each ligament, which is freely movable, containing the tube and ovary, can have nothing to do with supporting the uterus. The lower portion is much thicker and stronger. This has been termed the *cardinal ligament* of the uterus by Kochs, and the *transverse ligament* of the cervix by Mackenrodt." According to Eden, the transverse ligaments of the cervix, "described by Mackenrodt, consist of bands of firm, fibrous tissue, which form specialized parts of the visceral layer of the pelvic fascia; arising in the neighborhood of the ischial spine, they pass through the pelvic cellular tissue and are attached to the sides of the cervix and vaginal vault." According to Jellett, "Mackenrodt's ligaments are fibrous bands inserted laterally into the cervix and upper part of the vagina." He refers to these ligaments as "specialized bands formed from the endopelvic fascia."

If all the structures attached to the uterus except the cardinal ligaments be cut away, the uterus remains supported in the pelvis. The uterus can then be drawn down the vagina only by the exercise of strong traction on the cervix, and springs back to its original

[1] Address given before Section of Gynæcology and Obstetrics, Australasian Medical Congress, 1920.

Fig. 1. Anteroposterior vertical section of the pelvis showing the pelvic diaphragm (levator ani and fasciæ). *u.s.*, Uterosacral ligament, arrow indicating the pull on the uterus; and *v.v.*, the vesicovaginal fascia of Webster.

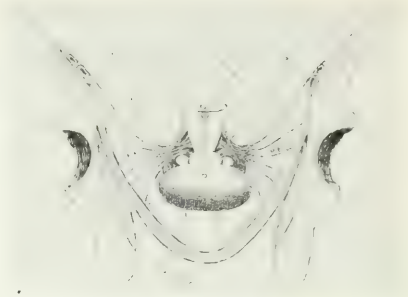

Fig. 2. Vertical section of the pelvis illustrating the relations between the cardinal ligaments and pelvic diaphragm. *u*, Uterus; *v*, vagina; *b*, bladder; *p. i.*, pars interna of the cardinal ligament; *p. e.*, pars externa; *v. b.*, vesical band; *s. s.*, fibrous strands passing up over the external iliac vessels. With intra-abdominal strain the levatores ani contract, and tighten up the pelvic fascia; this gives the cardinal ligaments a firm base to work from when they contract to prevent the uterus being driven downward; the upward pressure of the contracted pelvic diaphragm resists the downward pressure of the uterus and bladder. (Semidiagrammatic.)

position when the traction ceases. The supporting power and elasticity of the cardinal ligaments are in this way amply demonstrated.

*Uterosacral ligaments* (Fig. 1). If all the structures attached to the uterus except the uterosacral ligaments be cut away, the uterus sags back toward the sacrum, because their antagonist, the vesicovaginal fascia, no longer acts. When traction is then exerted on the cervix, the uterosacral ligaments are found to exercise no little resistance, although nothing like that of the cardinals under corresponding conditions. In the erect posture the uterosacral ligaments would appear, from the direction of their action, to assist in holding up the uterus, my personal view being that one of their functions is to reinforce the cardinals. Bearing on this is the fact that in lesser degrees of uterine prolapse curtailment of the overstretched uterosacrals, with remedying of retroversion, often cures the prolapse. Here the curtailed uterosacral ligaments hold up the uterus, and by giving the cardinals physiological rest encourage their contraction.

*Vesicovaginal fascia* of Webster (uteropubic ligaments of Schaffer and others). The uterosacral ligaments in contracting act as tensors of the vesicovaginal fascia and anterior vaginal wall; to this extent they play a part in supporting the bladder. With intra-abdominal strain in the erect posture the body of the uterus is driven down on to the bladder. As a response the action of the uterosacral ligaments tightens up the vesicovaginal fascia and anterior vaginal wall to resist the downward pressure of the uterus.

The *round ligaments*, by keeping the uterus anteverted, place it in the most favorable position for resisting intra-abdominal strain.

### GENESIS

A complete understanding of the anatomy and histology of the cardinal ligaments is consistent only with a correct appreciation of their genesis. From a study of the fœtus and of the cardinal ligaments in the adult I came to certain conclusions in 1916, which will now be outlined.

In an early stage of development there is adhesion between the pelvic fascia (and posterolateral wall of the bladder) on the one side, and the embryonal uterus about the

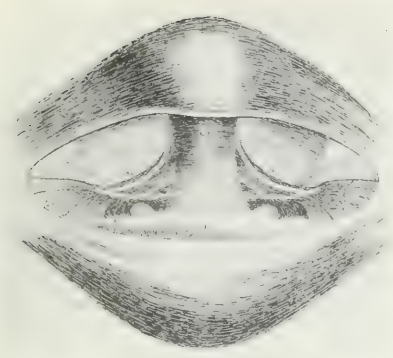

Fig. 3. The uterovesical pouch has been freely opened up, and the bladder turned down from the uterus and vagina. *ut.*, Uterus; *v*, vagina; *b*, bladder; *u.*, ureter; *p. i.*, pars interna of the cardinal ligament; *p. e.*, pars externa of the cardinal ligament; *v. b.*, vesical band. (From dissection made at the Melbourne Hospital, March 1, 1921.)

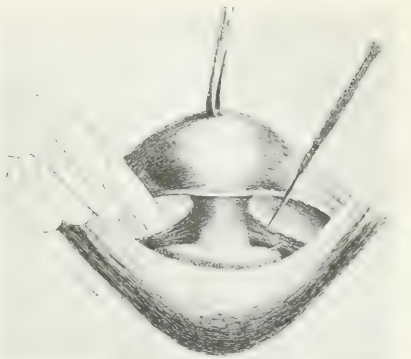

Fig. 4. The uterovesical pouch has been opened up to expose and isolate the surgical segment (pars interna) of the cardinal ligament in the operation of looping the cardinal ligament. The forefinger is behind the right segment, and an aneurism needle is passed under the left segment.

level of the future internal os (and the lateral vaginal fornix) on the other side. With retreat outward and general enlargement of the pelvic wall, the areas of least resistance in the adherent parts are drawn out into strands (muscular, fibrous, or mixed). The net result is the formation of a structure of a definite anatomical type extending from the side of the uterus and lateral vaginal fornix outward to the lateral pelvic wall, the inner segment (pars interna) being a definite fibromuscular band, and the outer segment (pars externa) consisting largely of fibrous strands spread out radiatingly. This structure is what is referred to when I speak of the "cardinal ligaments" (Fig. 2). I have adopted this term purely because of my conviction that these ligaments are the cardinal element holding the uterus in the pelvis.

The uterosacral ligaments will, I believe, be found to have a similar genesis, the presence of the rectum doubtless playing an important part in leading to the development of two ligaments. The uterosacral ligament is commonly described as a cord-like structure, but I regard this cord as the free edge of a flattened fibromuscular band.

## ANATOMY

A rational surgery of the cardinal ligaments is possible only by an accurate knowledge of their anatomy. Prior to my investigations, no such accurate knowledge had, so far as I know, been attained. Bearing on this, are the statements of authorities already quoted, and, as still further bearing on it, is the report in the *British Medical Journal* of a discussion on the "Supports of the Uterus" introduced by Professor Hastings Tweedy at the Royal Academy of Medicine in Ireland on the 14th of February, 1919. Professor Tweedy stated that "The uterus owed its stability to fibromuscular bands, radiating in every direction from the muscles surrounding the os internum . . . . They acted as true tendons." Professor A. F. Dixon said the support of the uterus "was mainly applied at the lateral aspect of the cervix and at the lateral aspect of the vagina. Here the subperitoneal tissue was packed with smooth muscle and connective-tissue fibers, radiating outward along the vessels and nerves which abounded in that region. The dense mass was continuous with the muscle wall of the cervix and the vaginal fornix, and not merely adherent to these structures; in front of these, it was

continuous with the muscular wall of the lateral angle of the bladder, and formed the ureteral sheath."

The anatomy of the cardinal ligaments just quoted represents some advance on that of the pioneers, but is hardly definite enough to have any practical value for the operating surgeon. The results of my own investigations will now be described (Fig. 3).

The cardinal ligament arises by three more or less well-defined fibromuscular heads, seen in perfection at full-time pregnancy (Fig. 3). The median head corresponds to the continuation inward of the transverse part of the uterine artery, and is given off from the side of the uterus at about the level of the internal os; the superior head arises immediately above the median head, the ascending part of the uterine artery curling up over its anterior surface; while the inferior head arises from the lateral vaginal fornix. These heads converge to form a strong fibromuscular band passing outward on the posterior layer of the broad ligament. At its outer end, toward the origin of the uterine artery, this inner or surgical segment (pars interna) of the cardinal ligament spreads out radiatingly into fibrous strands (pars externa) passing through the lateral pelvic cellular tissue, and inserted mainly into the pelvic fascia. These fibrous strands are reinforced by thin sheetings of condensed connective tissue extending across the spaces between the strands and connecting the strands together.

From the inferior margin of the body of the surgical segment a strong broad fibromuscular band is given off to the posterolateral aspect of the bladder in a position corresponding with the ureter.

The surgical segment (pars interna) of the cardinal ligament has posteriorly the posterior layer of the broad ligament, to which it is adherent; anteriorly is the posterior wall of the bladder. The transverse part of the uterine artery passes inward on the anterior surface of the body of the ligament, and then curls upward over the face of the superior head. The upper free margin of the surgical segment slopes downward and outward, while the lower margin is in relation with the posterior surface of the bladder. The ureter dips forward from the posterior layer of the broad ligament to pass beneath the outer end of the surgical segment, and then swings into the bladder.

## SURGERY

The foregoing investigations have permitted me to work out a scientific operation for uterine prolapse, as well as to render the operations of hysterectomy and parametric ureterotomy simple and safe.

*Looping the cardinal ligaments.* At the Australasian Medical Congress, of 1914, I described my operation of "Looping the Cardinal Ligaments" in uterine prolapse. The anatomical portion of the paper was illustrated by a beautifully dissected specimen made under my direction in the Melborune Hospital by Dr. C. Kellaway, who later was acting Professor of Anatomy in the Adelaide University, while the operation was illustrated by 5 successful cases. The first case was operated on July 9, 1913, and remains cured in the presence of an active life.

The operation is carried out through an abdominal incision, the utero-vesical pouch being freely opened up, and the bladder turned down from the uterus and vagina. The upper free margin of the surgical segment of the cardinal ligament is then defined, and the ligament bluntly dissected from the posterior layer of the broad ligament (Fig. 4). The uterine artery is now seen coursing along the anterior surface of the ligament, while the ureter may be seen and felt without difficulty. A threaded curved pedicle needle is passed under the lower margin of the ligament, a loop of the ligament drawn forward by the thread, and the base of the loop sewn down to the lateral aspect of the uterus.

For associated retroversion I graft on my operation of "Restoration of the Round Ligaments": the anterior layer of the broad ligament is split parallel to the round ligament, and the opening closed with a purse-string, thereby bringing about immediate contraction of the round ligaments. The free ends of these purse-strings are used to close the original opening in the uterovesical pouch. The uterosacral ligaments are then curtailed, while a torn pelvic diaphragm should be repaired.

*Hysterectomy.* The crux of the operation is the exposure and isolation of the surgical segments of the cardinal ligaments, as described. They are caught in clamps to control the uterine arteries, and the broad ligaments are clamped to control the ovarian and round ligament arteries. The cardinal ligaments and broad ligaments are divided internal to the forceps, Douglas' pouch opened up, the uterosacrals divided, and the vagina cut across. The stumps on each side are secured by a continuous ligature, the free ends being used to close the rectovesical gap. The actual hysterectomy requires only four forceps and two ligatures.

*Parametric ureterotomy.* The surgical segment of the cardinal ligament is exposed, and, if necessary, isolated. A stone in the ureter may then be extracted, a stab incision for drainage made into the vagina, and the uterovesical opening very carefully closed.

CONCLUSIONS

The facts submitted in this article, and the results obtained in uterine prolapse by operative treatment based on those facts justify me, I believe, in claiming that the opening propositions in regard to the supports of the uterus must stand as a satisfactory guide in surgical practice, while at the same time representing the solution of an important problem.

For the photographs of my drawings I have to thank Dr. Barker, Chief Resident Medical Officer, Perth Hospital.

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# ADENOMYOMA OF THE FALLOPIAN TUBE

By ARTHUR E. MAHLE, M.D., Rochester, Minnesota
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VON RECKLINGHAUSEN, in 1896, advanced the theory that adenomyomata of the fallopian tube originate in the wolffian body, since in 27 cases the histological picture resembled that of the primodial kidney. In only two instances could he trace any relation of the adenomyoma to the mucosa of the tube. The first case he explained as due to a rupture of the gland into the tube lumen; and the second, as a continuation of a union between a wolffian duct and a muellerian duct. His hypothesis completely overthrew the generally accepted opinion of the muellerian duct origin of tubal adenomyoma.

Kossmann, in 1897, demonstrated that the tube could supply gland elements, and that in a small number of cases he found the glandular inclusions in tubal adenomyoma derived from accessory tubes. He, therefore, advanced the hypothesis that these adenomyomata arise from the accessory muellerian ducts.

Chiari, in 1887, concluded that 6 of 760 specimens with tubal swellings which he examined postmortem were not tumors in the strictest sense of the term, but in reality products due to a chronic catarrh of the genital system. In one tube he saw signs of a recent inflammation, from which he concluded that the inflammatory condition in the remaining five had subsided.

Von Franque, in 1900, showed that the epithelial structures of the tubal adenomyomata are derived from mature mucous membrane by a process of inflammation. He found adenomyomata in cases of partially healed tuberculous salpingitis, and in cases showing chronic inflammation of the tube wall. Likewise Meyer, in 1903, found similar processes of inflammation in cases of tubal adenomyoma. Many of his cases were associated with tuberculous and gonorrhœal salpingitis, hydrosalpinx, and ovarian diseases.

Maresch, in 1908, investigated the origin of what he termed *salpingitis isthmica nodosa*, or

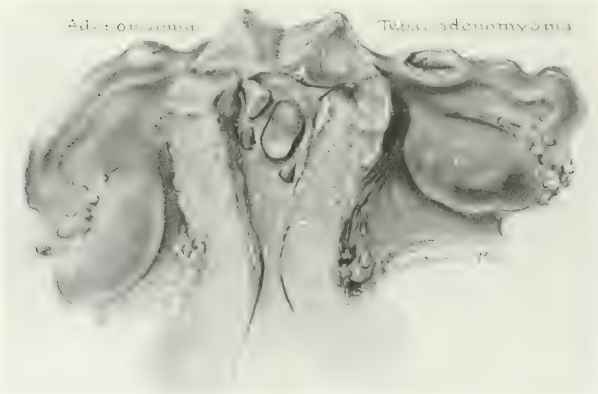

Fig. 1.—180378. The usual location of tubal adenomyomata is the proximal end of the tube.

adenomyomatous structures in the tubal angle. He relied on a large number of serial sections and also used the method of injecting the tubes. He was able by these methods to trace the origin of the adenomatous structures from mature tubal epithelium. In some tubes which showed an extensive glandular infiltration of the tube wall he was able to trace only one point of origin from the tubal mucosa. This explains why in a certain percentage of tubal adenomyomata no origin can be determined.

Cullen, in 1908, was able to trace the origin of adenomyomata of the uterus from mature uterine endometrium in practically every case he had studied, showing that a wolffian or muellerian duct could not be the origin of uterine adenomyomata.

From the findings of these later authors it seems strange that the hypotheses of von Recklinghausen and Kossmann gained such a foothold that even at the present time thay are incorporated in some textbooks.

The twenty-three cases of adenomyoma of the fallopian tube herewith reported were found at operations in the Mayo Clinic between January, 1910, and July, 1920. During this time 4,189 fibromyomatous uteri were removed, of which 332 (7.9 per cent) contained adenomyomata. This percentage is somewhat higher than that of Cullen's in 1908 (5.7 per cent) and of MacCarty and Blackman in 1919 (6.43 per cent). The increase is due no doubt to the added interest aroused by these writers on the subject. Twenty-three (6.92 per cent) of the 332 uteri contained tubal adenomyomata. In 14 (60.8 per cent) of the 23 we were able to trace a direct origin from mature tubal epithelium. In 6 cases, adenomyomata and tuberculous salpingitis were associated. In these the tuberculous granulation tissue in the tube lumen could be traced in to the tube wall surrounding the adenomatous structures. In three cases no direct continuation from the tubal mucosa could be demonstrated, but serial sections through the entire tube on the uterine side showed the absence of any gland structure. From this we conclude that the origin is most probably from the tubal mucosa, but due to the inadequacy of our methods of sectioning no direct point of origin from the tubal mucosa could be found. These latter cases are perhaps similar to those reported by Maresch who by means of very careful injection was able to trace but one point of origin from the tubal mucosa in a small percentage of his cases.

Fig. 2. Fig. 3. Fig. 4.

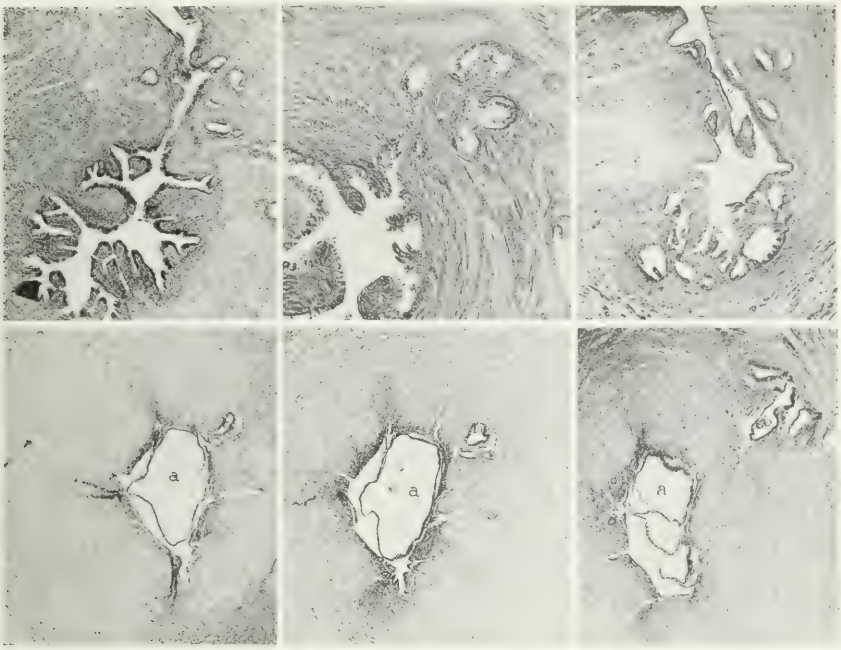


Fig. 5. Fig. 6. Fig. 7.

Fig. 2 (248153) and Fig. 3 (186669). Gland structure of an adenomyoma arising from mature tubal epithelium.

Fig. 4. (268280) The origin of a tubal adenomyoma and an associated subacute salpingitis.

Figs. 5, 6, 7. (180378) Photomicrographs of a series of sections showing, *a*, the origin of an adenomyoma of the tube from the epithelium of the tube lumen, and, *b*, the invasion of the tube wall (see Figure 1).

Of the 23 cases reported, 5 were associated with acute salpingitis, 6 with tuberculous salpingitis, 1 with hæmatosalpinx, 1 with hydrosalpinx, 1 with ectopic pregnancy, and 1 with papillary carcinoma of the ovary. One of the patients with acute salpingitis had been treated for a gonorrhœal infection 6 years previously.

All the specimens which were examined showed some evidence of an inflammatory reaction, from a moderate lymphocytic infiltration in some part of the tube to an acute purulent salpingitis. Other signs of pelvic inflammation, such as cystic ovaries, tarry cysts, and pelvic adhesions, were found in the remainder of the cases.

Grossly, these tumors are situated in the proximal end of the tube and isthmus, and appear as small swellings varying from a slight, scarcely noticeable, thickening of the wall of the tube, to a mass 1 centimeter to 2 centimeters in diameter (Fig. 1). The process, as a rule, is circumscribed, though in one case it extended through the entire length of the tube.

The cut surface is fibrous and gray with here and there small glistening areas which microscopically are gland spaces. The areas of old

Fig. 8. Fig. 9. Fig. 10.

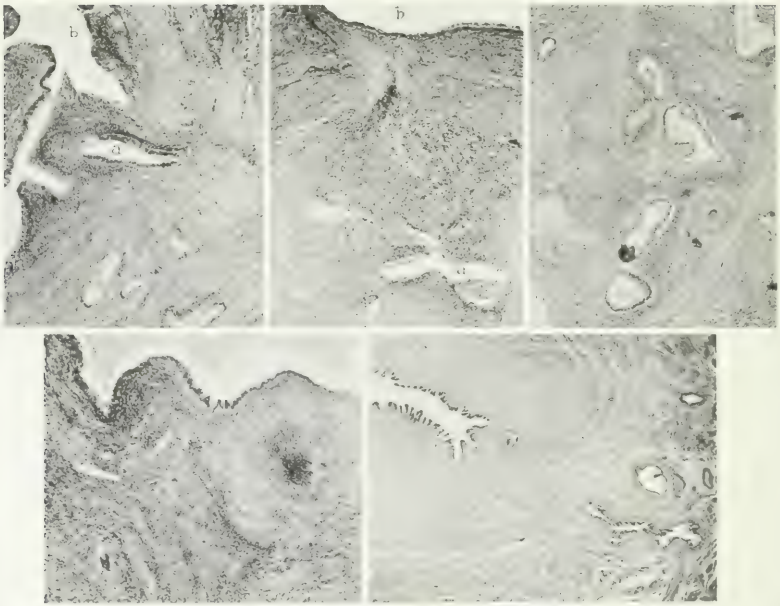


Fig. 11 Fig. 12

Fig. 8. (310572) Adenomyoma of the tube with an associated acute salpingitis. The gland structure, *a*, is breaking away from the tube lumen, *b*, carrying with it muscle fibers from the inner longitudinal muscle.

Fig. 9. (310572) Adenomyoma of the tube associated with an acute salpingitis, showing tube lumen, *a*, with a hyperplastic cellular mantle confluent with that surrounding the adenomatous structure, *b*. This is a section of a series taken adjacent to section shown in Figure 8.

Fig. 10. (103082) Adenomyoma of tube associated with tuberculosis.

Fig. 11. (73421) Adenomyoma of tube associated with tuberculosis.

Fig. 12. (73421) Adenomyoma of tube and a tuberculous salpingitis in other portions of the tube (see Figure 11).

hæmorrhage that are frequently noted in uterine adenomyomata are not seen.

Twelve (52.1 per cent) of the adenomyomata were bilateral, 7 (30.4 per cent) were on the right side, and 4 (17.4 per cent) on the left.

Histologically the glandular structures of tubal adenomyomata are immediately surrounded by smooth muscle fibers (Figs. 2 to 12). The cellular mantle, so common in uterine adenomyomata, is either absent entirely or only very thin. This may be due to the fact that the tubal adenomyomata arise in the proximal end of the tube where the tube lumen is closely surrounded by smooth muscle.

The average age of our patients was 37½ years, the eldest 64 and the youngest 17 years. A history of previous pelvic infection was noted in 34.7 per cent of the cases. Eighteen (78.25 per cent) of these patients had never given birth to living children and 15 (65.2 per cent) had never been pregnant. Of the 5 patients who had living children, 2 had been pregnant 23 and 24 years previously and one, aged 50, had in association with the adenomyoma a papillary carcinoma of the

ovary which had transplanted itself into the tube. Only 2 patients of the 23, therefore, aged 29 and 32 years, apparently have had normal pregnancies.

Ninety-one and three-tenths per cent of the patients gave a history of abdominal pain and 43.4 per cent complained of a vaginal discharge. The average duration of symptoms was 31.3 months. No other definite clinical symptoms were noted.

## CONCLUSIONS

1. The term "tubal adenomyoma" is a correctly applied term to adenomyomata arising in the tube, since the origin of the glandular portion is from the mature epithelium of the tube.

2. The hypotheses of the origin of tubal adenomyomata from the wolffian and muellerian ducts are untenable.

3. Tubal adenomyomata are in every case associated with an inflammatory condition and most probably are end products of the process of inflammation.

4. Some relation exists between sterility and the presence of adenomyomata of the fallopian tube.

5. There are some slight histological differences between tubal adenomyomata and those commonly found in the uterus, but this difference is most probably due to the place of origin and subsequent development and not to the etiological factor.

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# SUCCESSFUL END-TO-END SUTURE OF THE COMMON CAROTID ARTERY IN MAN

By HARRY G. SLOAN, M.D., F.A.C.S., Cleveland

SUTURE of the common carotid artery appears to have been one of the rarest of operations since, in a careful study of the literature, the author has been able to find but eight cases, each occasioned by an aneurism. Dr. V. Parczewski (1) records a case of arteriovenous aneurism of the common carotid in a man of 21 in which the vessel was closed by a circular suture after the removal of about 2½ centimeters. No neurological symptoms followed. He states that a careful study of the literature has led him to believe that this is the first case of its kind recorded.

H. von Haberer (2) reports one case of lateral suture of the common carotid for aneurism out of a total of 42 operations for aneurism, and 4 cases of circular suture for aneurism following war wounds.

Lexer (3) records a case of traumatic aneurism involving both the artery and the vein in which a resection of 3 centimeters of the common carotid was made. The age of the patient is not stated. "During the operation the common carotid was closed for 1 hour. Paralysis of the opposite leg cleared up the same evening, whereas the paralysis of the arm on the same side took 4 weeks to disappear." The author explains this difference as due to the inverted localization in the cortex, the motor centers for the foot and leg being nearer the mid-line of the cerebrum than the arm center, so that the former derived some collateral circulation from the opposite hemisphere.

Dr. W. Denk (4) reports a case of aneurism of the left common carotid in a soldier of 20 years, in whom he united the vessel by a circular suture after the removal of 2 centimeters. This case is of especial interest as it is the only one of the eight reported cases in which the presence and continuance of pulsation in the temporal artery on the side of the resection was noted.

Experimental findings have shown that the recovery rate after ligation of the common carotid is 33 per cent. It follows, therefore, that survival does not necessarily prove that the carotid is patent after circular suture, especially in young patients, unless the temporal pulse is demonstrated.

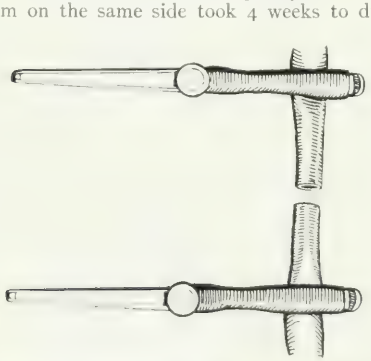

Fig. 1. Ends of the artery have been stripped of adventitia, freed and are ready for the placing of guy sutures.

Our patient, aged 56, presented himself in July, 1920, with a recurrent carcinoma of the lower lip and neck. The primary lesion was a squamous-cell carcinoma of the left lower lip which had been operated on elsewhere. Three months before, Dr. Crile had excised the gland-bearing area of the left side of the neck and the lower triangle of the right side, the latter excision necessitating the resection of 1.5 centimeters of the internal jugular vein on account of the invasion of its wall by the new-growth, extending from an infected gland at the junction of its middle and lower thirds.

The plan of the final operation was to clean out the superior triangle on the right side as there was an enlarged gland just at the angle of the jaw. During the sharp knife dissection in the deep planes of the neck, where the previous excision of the inferior jugular vein had occurred, we nicked the common carotid as it lay in a mass of scar tissue. In the attempt to catch the supposed spurter, the carotid was caught with a hæmostat which immediately cut through the sclerosed vessel walls. Before the bleeding was controlled by finger compression above and below the bleeding, the vessel wall was badly damaged by hæmostats for about three-fourths of a centimeter, the damaged portion encroaching on about half of its circumference.

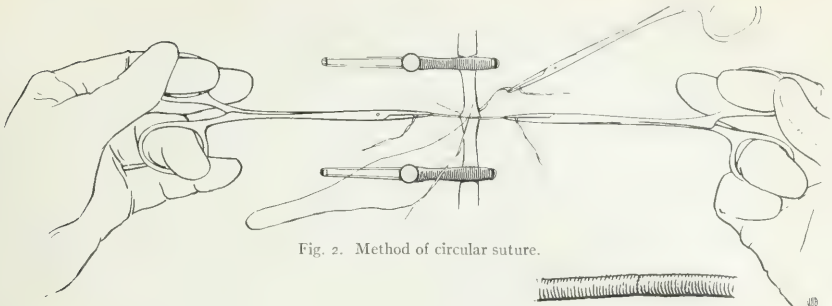

Fig. 2. Method of circular suture.

Fig. 3. Suture line completed.

We fully appreciated the danger to life at this age if the common carotid were ligated. Twelve years previously I had helped Dr. Crile in the excision of the left external and internal common carotids in a man of 28 who was suffering from an endothelioma of the common carotid gland, which had invaded the vessel walls. Following the operation he was delirious for 3 days. His right leg was weak and dragged for 5 weeks, but ultimately recovered its full strength. Clinical experience has taught that the older the patient, the greater the danger from ligation of the common carotid artery because of the greater difficulty in maintaining efficient collateral circulation through the more rigid vessels.

In regard to the repair of the vessel, we have found it easier to do an end-to-end anastomosis than to make a lateral repair of the vessel wall. Moreover, in this instance a lateral repair of the vessel wall would cut down the blood supply to that side of the brain by probably two-thirds. In addition there is evidence that a thrombus will more probably be formed distal to a lateral suture of a blood vessel. This is because of the greater opportunity for stasis in the peripheral back eddy of the blood stream just after it passes a constricted point in the vessel lumen. We, therefore, decided to excise the damaged area of the vessel and make an end-to-end anastomosis. After making an ample exposure of the artery, we clamped off the vessel proximally and distally to the rent with carotid clamps which had their jaws protected with rubber tubing. The damaged area of the vessel, 8 millimeters in length, was excised; and the loose tissue was cleaned off from the cut ends (Fig. 1). In order to approximate the divided artery without tension, we raised the patient's head on a small pillow and then rotated it on the longitudinal axis of the body, fifteen degrees away from the side on which we were operating. In other words we turned the man's face toward his left, and at the same time approximated the head and right shoulder. The patient had a rather heavy neck so it was difficult to get sufficient room in which to work as we had to make our suture in the vessel only about 4 centimeters above the clavicle. However, by using a mosquito hæmostat for a needle holder, we succeeded in placing the sutures. We employed Carrel's original method of

Fig. 4. Patient after operation.

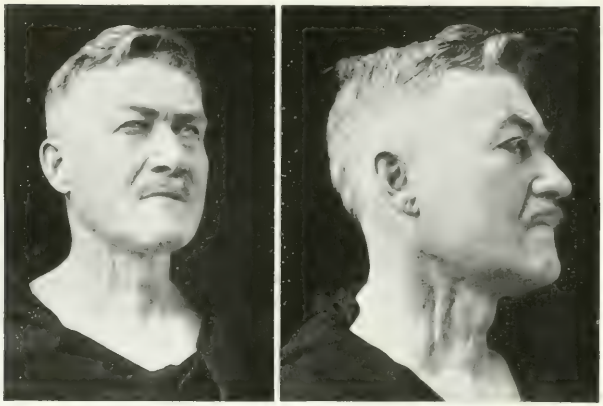

Fig. 5. Patient five months after operation.

suture, i.e., three guy sutures through all the coats of the vessel, and then a continuous over-and-over suture, joining the cut ends of the vessel (Fig. 2). We used straight No. 16 needles and triple ooo linen, split twelve times. Needles and sutures were well lubricated with vaseline. The approximation of the cut ends of the vessel was made by traction on the successive guy sutures.

On account of the proximity to the clavicle and the shortening of the blood vessel, the most difficult part of the suturing was on the posterior aspect of the vessel between the first and third guy sutures. Moreover, the vessel wall was quite sclerosed, and had very little elasticity. The patient had a moderate degree of sclerosis of his large vessel and at the time of operation his blood pressure was 156 millimeters mercury systolic, and 100 millimeters mercury diastolic. It was possible to peel off a ring from the cut end as one would uncurl the end of a coiled spring. In removing the distal carotid clamp when the suture line was finished, we found two places from which fine streams of blood spurted. A single stitch at each of these points made an absolutely tight suture line that allowed no leakage whatever. The suture line was further protected by pulling the deep fascia over it and stitching it in place (Fig. 3).

After the repair of the carotid artery was completed we proceeded with the dissection of the neck. The gland-bearing area of the superior triangle was excised *en bloc*, and the skin closed with clips. During the operation, the circulation was cut off from the right side of the brain for 30 minutes; but on completion of the operation, we were able to feel pulsation in the temporal artery on the side of the sutured carotid. The second day after the operation the pulsation in the right temporal artery was of about half the volume of that of the opposite side. However, on the third day, the pulsation on the two sides was of equal volume, and has so continued ever since. Recovery from anæsthesia was not delayed, and at no time since the operation have there been any nervous symptoms or any abnormal response in the deep reflexes of the opposite side of the body, nor has there been any change in mentality. The patient made an uninterrupted convalescence and has been at work for the last two months (Fig. 4).

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# ABDOMINAL PREGNANCY WITH LIVING CHILD

By E. C. MOORE, M.D., F.A.C.S., Los Angeles, California.

THERE are many cases of abdominal pregnancy on record where the fœtus has been found either dead or only a few months old. The number of cases going to term with delivery of a living child are much less numerous, while those where the mother survived and the child lived a year or more are exceedingly rare.

Kelly, in his *Operative Gynecology*, 1898, gives a table of 77 cases of ectopic viable fœtus delivered under cœliotomy from November, 1809, to November, 1896. Thirty-five of these infants died within 50 hours of birth and only 7 are recorded as having lived for one year or more. Probably more than seven, however, survived because the data on this point seem to be incomplete.

The object of this paper is to put our case on record, and to mention a few cases which have been found in the literature where it is positively certain that the mother survived and the child lived for at least one year.

The first four cases have been taken from Kelly's table. In order to identify these cases the operator's name is given.

1. Treub. Operation, May 29, 1887. Mother recovered. Child well at seven and one-half years.

2. Olshausen. Operation, November 1, 1888. Mother recovered. Child well at one year.

3. George Rein. Operation, February 4, 1890. Mother recovered. Child living in 1894.

4. M. Price. Operation, October 23, 1892. Mother recovered. Child well in 1897.

5. Horsley (4) mentions Lockett's case where the mother recovered and the child was living 20 months after operation.

6. J. S. Horsley (4). Operation, December 13, 1911. Child found among the intestines, covered only by a thin membrane. The placenta and sac had a distinct pedicle coming from the left broad ligament. The baby was a well formed boy weighing 6 pounds. Mother and child were both well more than a year after the operation.

Sittner (7) has made a very comprehensive survey of the literature on this subject and has collected 179 cases of extra-uterine pregnancy with viable fœtus delivered by cœliotomy. He has written three articles on this subject, in the first one of which he collected 121 reported cases taking in the years 1813 to 1900. In his second article he adds 15 more cases, bringing his statistics up to 1902. His third article comprises 43 additional cases found from 1902 to April 19, 1906, making in all 179 cases. Some of these fœtus had not gone to term, but there were 122 which were more than 32 weeks old. Fifty-nine of them, or 48.3 per cent died, within 4 weeks of delivery, showing that 51 per cent of these children lived more than 1 month. There are eight cases among those last collected by Sittner which conform with the requirements of this paper. Only the briefest possible reference to each case will be made because those who are especially interested can easily obtain Sittner's original article.

7. A. Benckiser, Karlsruhe. Operation, February, 1899. Mother survived. Child (male) living in 1906. (Case No. 11.)

8. A. Fischer, Tiflis. Operation, October 4, 1902. Mother survived. Male child died at the age of 2 years. (Case No. 24.)

9. G. Calderini, Bologna. Operation, June 12, 1903. Mother survived. Child, female, living in 1906. (Case No. 27.)

10. H. Schmit, Linz. Operation, July 17, 1903. Mother survived. Male child living in 1906. (Case No. 28.)

11. R. Chrobak, Vienna. Operation, November 17, 1903. Mother survived. Female child living in 1906. (Case No. 33.)

12. D. Popoff, St. Petersburg. Operation, September, 1904. Mother survived. Male child died at the age of 15 months of intestinal catarrh. (Case No. 35.)

13. Th. Landau, Berlin. Operation, March 20, 1905. Mother survived. This child, male, was under Sittner's personal observation and at the age of 2 years was reported by him as living and well. (Case No. 39.)

14. J. Jerie, Prague. Operation, September 12, 1905. Mother survived. Female child reported to be living on November 27, 1906. (Case No. 42.)

15. F. A. Dorman's (2) case operated April 25, 1917, within 1 week of term. The sac was found to be connected with the right broad ligament. Uterus was the size of a 3 months' pregnancy, contained four fibroids, and had a large pedunculated fibroid attached to the left horn and a small one to the right horn. The child was a girl weighing 6 pounds and 14 ounces. The mother recovered.

16. F. A. Dorman's second case, operated upon November 17, 1917, 12 days before estimated term. This case, like the preceding one, was intraligamentous, the attachment being to the left broad ligament. A living baby girl weighing 4 pounds and 11 ounces was delivered. The mother recovered. In a letter received from Dr. Dorman, dated November 2, 1920, he writes: "Up to reports of very recent date both of the ectopic babies reported by me were in excellent health and developing normally."

17. N. L. Hood (3). Operation, December 22, 1909. A living girl baby weighing 7½ pounds was removed from the sac. There was a concavity on the left side of the child's head caused from resting against the vertebral column. The sac was between the layers of the right broad ligament, the placenta lying partly on its anterior wall and partly on the uterus. The mother recovered, but had to have a secondary operation for a sinus which extended down into the pelvis. This closed in August, 1912. The child at the age of 3 appeared normal in every way.

18. Horsley (5) in his second article mentions the following two cases. C. Adjaroff's case. Mother and child perfectly well two years after operation.

19. Potocki's case. Mother recovered. Child was living at 2½ years of age, but was deaf and dumb.

20. Dubose's case mentioned by Lee (6) deserves especial attention, as it seems safe to say it probably is the only one of its kind. A negress, 35 years old, had given birth to an apparently full-term baby. The midwife who confined her recognized the presence of twins, and not being able to effect a delivery of the second child, sent for aid. A diagnosis of abdominal pregnancy with viable fœtus was made and the patient operated upon the next day. A large right ovarian amniotic sac was found with pedicle from the top and upper posterior surface of the right broad ligament. This was ligated and the entire sac and placenta removed. The extra-uterine child weighed 2 ounces more than the intra-uterine child. The convalescence was uneventful and the mother and both children were normal 22 months later.

The history of my case is as follows:

The patient, Mrs. N., 29 years of age, was pregnant for the first time, although she had been married for more than 5 years. Her last menstruation came on March 12, 1915, but was not normal, as she flowed only 1 day, whereas the flow usually continued about 5 days. Shortly after this she began to have morning nausea and enlargement of the breasts. For about 6 weeks the pregnancy seemed to progress normally, then she began to have severe cramplike pains in the lower abdomen. These pains came and went for about 2 weeks, when early one morning she was seized with excruciating pains in the lower abdomen, more pronounced on the right side. She felt very faint and had to vomit. Her attending physician advised an operation at this time. She remained in bed for 10 days, occasionally having a great deal of pain, which gradually became less severe. Quite frequently between the second and third months there was a slight bloody vaginal discharge. During the sixth month of pregnancy she had very little pain, but from that time on she vomited a great deal and the fœtal movements caused much pain. On November 12, 1915, her physician, Dr. Speicher, decided something must be done to relieve her and asked Dr. M. L. Moore to see the patient in consultation. Upon examination, the position of the child seemed abnormal, the cervix small and undilated, so an abdominal operation was advised. The patient would not consent to this until November 27, 1915. At operation, I found the omentum and small intestine adherent to the anterior abdominal wall, which, after separating, showed a large mass covered by small intestine and omentum, showing recent inflammation and covered with lymph. The mass had the appearance of a twisted pedicle cyst. The veins in the omentum were decidedly enlarged. The uterus was about the size of a 3 months' pregnancy and was pushed to the left by this mass. The mass was attached to the posterior surface of the right broad ligament and to the lateral pelvic wall and also extended up toward the liver, being attached to the omentum in this region. The colon was free from any attachment. The cord from the placenta extended to the left up under the spleen where the child was found free among the intestines, not surrounded by any sac. The intestines on the right side were more or less adherent to one another, due to the fact that the membranes were adherent here to the coils of intestine. Clamps were placed on the broad ligament below the attachment of the placenta and the entire broad ligament with placenta was removed *en masse*. The child was a girl weighing 5 pounds and 9 ounces and had no deformities. In a letter received from the mother, dated November 12, 1920, she states that both she and her little daughter are well.

This makes 21 authentic cases and undoubtedly many others could be included if it were possible to obtain the necessary information. Cragin's (1) five cases illustrate this point. The five mothers operated upon by him made good recoveries. Two of the infants were dead at the time of operation and the remaining three left the hospital in good condition. One was reported normal at the age of 5 months. Because of Dr. Cragin's death it has been impossible to learn the fate of these three children.

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# THE WEAK SPOT IN AMERICAN SURGERY[1]

By THOMAS S. CULLEN, M.D., F.A.C.S., Baltimore

TO the outside world the members of a well regulated family usually present an unbroken front amid the cares and turmoil of a busy life. In the bosom of the family, however, all reserve is removed, and the various members feel themselves free to discuss one another's shortcomings and proffer suggestions as to the ways by which betterments may be made.

As members of the College of Surgeons we are in reality members of a large surgical family and it is not only our privilege but also our duty to speak out freely in these family gatherings, and to suggest means whereby the surgery of these United States and Canada may be improved.

When our distinguished colleague, Dr. Franklin H. Martin, who, more than any other man has been instrumental in the advancement of the College of Surgeons, asked me to speak at this state meeting I gladly consented, and in casting around for a suitable topic one subject kept continually presenting itself—*The Weak Spot in American Surgery*.

When we survey the surgical field and see what has been accomplished in abdominal surgery, in gynecology, in the surgery of the neck and recently of the brain, and remember how orthopedic surgery and surgery of the nose and throat have advanced we are naturally filled with pride. But let us not for a moment forget that the advancement along these lines has in large measure been rendered possible as a result of the fundamental labors of Pasteur, Lister, Koch, and a few others. Had it not been for the epoch-making discoveries of these men our remarkable advances in surgery would not have been possible.

Bacteriologists have not only shown us the way but have also in large measure removed the nightmare of tetanus by giving us a curative antitoxin.

## SURGICAL PATHOLOGY

In some of the larger hospitals there has been a very close co-operation between the surgeon and the pathologist for the last 25 or 30 years. In these hospitals the surgical cases have been carefully described, the surgical procedures have been given in detail, the material removed has been examined macroscopically and microscopically, the immediate and after-results have been recorded with precision, and finally, the composite picture of the given surgical disease has been followed from beginning to end. In other words, the sap has been collected, boiled down, and we have the sugar. The results of long years of observation and study have been concentrated into definite concrete surgical facts.

Those of you who have had the pleasure of being in the sugar bush know that it takes barrel upon barrel of sap to make a relatively small amount of sugar. It has taken an infinite amount of labor and many observations to establish a few certain surgical facts, facts of inestimable value not only to the surgeon but also to the patient.

## THE ADVANTAGES THE SURGEON HAS OVER THE PATHOLOGIST

The surgeon, when he opens the abdomen, sees the exact relation of the diseased area to the surrounding tissue. On the other hand, when the pathologist receives the specimen this setting has often entirely disappeared.

[1] Address before Texas and Oklahoma State Sections, Clinical Congress of American College of Surgeons, Dallas, January 7; and before the Members of Louisiana and Mississippi State Sections, New Orleans, January 10, 1921.

For example let us take a fallopian tube that has been converted into a hydrosalpinx, 3 centimeters in diameter, and that is adherent to the pelvic floor. While the tube is being loosened, its fimbriated end may rupture and the fluid escape. Such a tube when it reaches the pathologist may not be much larger than a normal tube and apart from a few adhesions the pathologist finds nothing wrong. How impossible it is for him to form an adequate idea of what was really found at the time of operation.

Again, let us take the specimen from a chronic appendicitis. The acute inflammation has subsided and at operation the appendix is normal in size but buried in adhesions. And yet, despite the fact that the patient has been relieved by an appendectomy, the pathologist may find little or nothing to indicate why it was necessary to remove the appendage.

Again, the manipulation during the operation may totally alter the form and relation of the structures removed. Let us take a case of pelvic inflammatory disease with dense adhesions. The operator sees the exact relation. If a bisection has been done and each half of the uterus has been removed separately and then the tubes and ovaries tied off on each side, the pathologist receives four pieces of tissue which are with difficulty replaced in their normal relation.

Those of you who have used the binocular microscope have noted how graphically the three dimensions are brought out. With two eye-pieces you focus down on the one object. Now let us suppose that the surgeon looks through one eye-piece, and the pathologist through the other, neither can possibly get the full value of the picture. Metaphorically speaking, if the surgeon wishes to get an adequate picture he must use both the eye-pieces —in plain English he must be not only a surgeon but also a good pathologist.

### WHAT A KNOWLEDGE OF PATHOLOGY MEANS TO THE SURGEON

Frequently the surgeon on opening the abdomen is in a quandary as to what he should do next. He sees one or more suspicious areas and says to himself: "If I only knew exactly what these areas were I would go ahead or back out." In such cases he usually closes the abdomen without doing anything. On the other hand, the surgeon who is a good pathologist has on previous occasions been in just such a dilemma but from frozen sections of the tissue has been able to determine the exact condition, and has either operated or desisted as the case might be. After a few such experiences he is often able to determine with relative certainty the actual condition from visual inspection, while in the doubtful cases he may again resort to the frozen section.

A thorough knowledge of the histological appearances of uterine scrapings is of great importance to the surgeon. Where a suspicious appearance of the cervix exists he cuts a piece out, has it examined at once, and if malignancy exists does a complete hysterectomy. If he be not a pathologist and has no expert at hand it may take days or weeks before he can know exactly what he is dealing with, so that valuable time is lost, and the patient suffers prolonged anxiety and added expense. Incidentally, it may be said, the specimen is sometimes lost in the mails.

When malignancy is suspected in the body of the uterus, curettings are obtained, the diagnosis is usually made in a few minutes, and the appropriate procedure carried out. In no other surgical field does a close co-operation between the pathologist and surgeon bring about such brilliant results as in the examination of uterine scrapings.

The surgeon's knowledge of the histological architecture of the pathological condition he is dealing with is often of great practical import. For example, on opening the abdomen he finds a very large multilocular ovarian cyst. On inspection he notes that it conforms in every particular to the common multilocular cystadenoma. He knows that this is benign, and accordingly can with impunity tap it and remove it through a relatively small incision, feeling certain that if a few drops of the fluid should escape into the abdomen it will do no harm.

On the other hand, if the cyst walls are very thin and the cysts few in number he will think of colloid carcinoma and will accordingly make a long incision and remove the tumor

intact, because if some of the cyst's contents escape, secondary implantation may take place on the peritoneum.

Again, when he is dealing with a large multilocular adenocystoma densely adherent to many loops of small bowel in the pelvis and also inseparably adherent to the pelvic wall he will remember that the outer walls of the cyst are composed of laminated connective tissue and that they contain no epithelial elements. Recognizing this important fact he will make his incision very superficially through the outer cyst wall in the pelvic region, and will shell the main tumor out. In this way he will leave a thin shell of connective tissue in the pelvis which is relatively innocuous and will convert a most difficult or impossible operation into a relatively easy one.

The trained surgical pathologist is always on the lookout for new conditions or for links in a process that is as yet not thoroughly understood.

A few weeks ago I did a supravaginal hysterectomy for a multinodular myomatous uterus. Myomata are so common that most of us at times tire of removing them. In the cul-de-sac, however, in this case, I found a lobulated pedunculated nodule, approximately 11 centimeters in diameter, and densely adherent to the sigmoid. As it was shelled out I noticed bluish cysts beneath its surface, and also a rusty area about 1 by 2 centimeters in diameter. In brief, the tumor was a pedunculated, subperitoneal adenomyoma. In over 25 years I have never seen such a specimen, and it demonstrated very clearly how these tumors may in time form immobile and irremovable adenomyomatous growths in the pelvis. Such a tumor means infinitely more to the surgeon than any remuneration he might receive for his services, and he would gladly travel far to obtain so invaluable a specimen.

On November 17, 1920, I operated on a young woman, 24 years of age, for a chronic appendicitis. She had asked me to be sure and examine the right ovary as she thought there was something wrong with it. I drew the ovary out through the gridiron appendix incision and found that it was about half as large again as normal. Seeing a few rather large follicles I punctured them thinking that the increase in size of the organ was due merely to these simple cysts. A fine straight intestinal needle was used. The first cyst yielded a few drops of clear colorless fluid. The second and third contained similar fluid. The ovary, however, being still a little too large, I passed the needle deep into its substance where no cyst was apparent, and immediately there escaped probably a fourth of a drop of an oily fluid. This would doubtless have been overlooked had it not been for the whiteness of the surface of the ovary, and the excellent electric illumination which fell on it at an angle. The oily fluid, although very scant, gave a shimmering effect, which at once told me that we had to deal with a dermoid cyst. An elliptical incision was made over the surface of the ovary and a dermoid cyst, 3.5 centimeters in diameter, was at once encountered. It was shelled out intact and about two-thirds of the ovary left. Had it not been for the systematic puncture, the excellent illumination, and the immediate recognition of the oily fluid as indicative of a dermoid cyst, it would have been overlooked, and the patient would have in all probability been compelled to return for another abdominal operation in from 6 months to a year.

A thorough knowledge of surgical pathology is of inestimable value to the surgeon. Even when alone, he always has the advice of a competent pathologist—if he has had a thorough "binocular" training.

### HOW SHALL WE OVERCOME OUR WEAK SPOT OUR LACK OF PATHOLOGY?

Very easily. Let each surgeon have associated with him a good pathologist. Just so. But in the first place at present there are not enough pathologists to man adequately our existing medical schools. In the second place the trained pathologist is too valuable a man to spend his time around the operating room for half of the day in order to help out the diagnosis in three or four cases; he would lose too much time. In the third place, many small clinics cannot afford to pay a real pathologist.

It is clearly evident then that many years would elapse before all operative clinics

would be able to profit by the services of a pathologist.

But suppose we send our pathological material to a distant laboratory. This has definite drawbacks. In the first place the surgeon cannot command the advice at the operating table which is so often necessary. Again, there is frequently much delay in packing and forwarding the material to the laboratory and not infrequently specimens are lost. Lastly, the fact that the surgeon in some cases must wait days or weeks for the pathological report not only adds greatly to the patient's hospital expenses but what is even more important it has a bad effect on the surgical assistants. When the case is fresh in their minds they grasp it as a definite clinical entity, but when days and weeks pass before the report is given, they may miss the laboratory diagnosis, or if they do learn it, it does not make the same indelible impression upon them.

No well regulated business house would be satisfied with such a cumbersome and slow method and the long period of suspense will often create an unfavorable impression on the patient. This method of procedure, although valuable, is only a make-shift—we must do better.

Scattered throughout the country are a few laboratories where surgical pathology is systematically taught and where graduates in medicine can obtain a thorough knowledge of the surgical pathology of the branch in which they are specializing. Every surgeon looking around for a wide-awake assistant should insist that the applicant have at least one year's training in the surgical pathology of his special branch. The earnest young man will immediately appreciate its value and will at once place himself under the tutelage of a good surgical pathologist for a year at least. At the end of that time he will be invaluable to the surgeon and will in most instances be able to advise the operator during the operation as to the exact condition present, and whenever a frozen section is necessary, a technician can at once make the required section and the assistant render an intelligent opinion then and there. This clearing up of the diagnosis will not only enable the operator to do more intelligent work but will also be of great value to the patient. The assistant will likewise supervise the examination of all pathological material coming from the operating room. This will still further add to his knowledge of surgical pathology.

In 1891 I applied to Dr. Howard A. Kelly asking if I might enter his department as an interne. He said: "Yes, I will take you, but you must first spend several months with Dr. Welch and Dr. Councilman studying in pathology and bacteriology."

In due time the assistant becomes a full-fledged surgeon himself and having realized to the full the value of a fundamental knowledge of surgical pathology will insist that all those coming to him for surgical training shall be well grounded in the pathology of surgical diseases. In this manner there is no reason why the surgeons of the next decade should not all have a comprehensive knowledge of their own particular branch.

### THE TRAINING OF THE ASSISTANTS IN THE GYNECOLOGICAL DEPARTMENT OF THE JOHNS HOPKINS HOSPITAL

Each year four of the graduating class are assigned to the gynecological department. During the year these men have charge of the patients in the private and public wards, take all the histories, assist at operations in the morning and work in the gynecological and cystoscopic dispensaries in the afternoon.

At the end of the year, after a conference with the house staff and the visiting staff one of the four men is picked out for promotion. The other three obtain hospital appointments elsewhere or enter private practice.

The man who has been selected now drops out of the gynecological department for a year and becomes an assistant of Dr. William G. MacCallum, professor of pathology. During his interne year this man has obtained a very good idea of the difficulties encountered in the various abdominal and pelvic operations and consequently is better able to appreciate the opportunities afforded him in the pathological department. He is, however, no novice in this laboratory because in his undergraduate days he received his instruction here.

He is now permitted to make numerous autopsies and gains a clear idea of gross patho-

logical lesions. While making the autopsies he has the opportunity of dissecting out the ureters and of learning the relations of the pelvic structures. He is continually dissecting out the bile-ducts to see if they are patent and has ample opportunity to observe carefully the lymphatic ducts. He also gains a lasting knowledge of the relations of the abdominal organs and of the blood supply. After a year's opportunity in such work he can never again get lost in the abdomen (How many of us would gladly embrace such a year's training even now!). In addition to all this he gains an insight into the lesions in all parts of the body, and has the opportunity of studing the histological picture of the various lesions noted at autopsy. He likewise has the privilege of attending again the undergraduate classes in pathology and of participating in the invaluable pathological conferences that are held each week.

I cannot let this opportunity pass without publicly thanking Dr. MacCallum for the rare privilege he has accorded the junior men of the gynecological department. I personally am also under many obligations to him because as a result of the extra year's training in general pathology the incoming man will have a much wider grasp of gynecological pathology.

At the end of a year our assistant in pathology returns to the gynecologial department, he examines and describes all material coming from the gynecological operating room, supervises the cutting and staining of sections, and gives a careful and detailed description of the histological findings. Ample time is afforded him to work on special gynecological problems and he is within easy distance of that mine of information, the Surgeon General's Library, where practically every book and every periodical that is worth reading can be obtained. He also has an opportunity to see all the interesting cases treated in the department.

During the following year he is first assistant, assists at operations, has general supervision of the wards, and when the resident is away is in charge.

During his final or fifth year he is the resident gynecologist and has full charge of the department and in addition to assisting the visiting surgeons performs many major and minor operations himself.

The finished product is:

1. A man who has a good knowledge of general pathology;
2. One who has an intensive knowledge of gynecological pathology and is the author of several papers on this subject;
3. A man with a comprehensive knowledge of gynecological and abdominal diseases;
4. An expert gynecological and abdominal surgeon;
5. One who has formed the habit of looking at his cases from every standpoint.

A man with such a training will not only do justice to his patients but should also prove an admirable teacher. He is bound to add to the sum total of our knowledge of gynecology and abdominal surgery. Few men who have become real investigators will ever be satisfied to relinquish this fascinating field during their active period of surgical life.

In years past many general practitioners gradually drifted into surgery. This is rarely possible today, as an adequate apprenticeship now requires several years of intensive study.

Those of us who graduated 30 years ago could not be expected to know surgical pathology. The same applies to the man who has been in practice 20 years, but the man who has entered the surgical field during the last decade has not the same excuse. If he has sought diligently he could have found some excellent teachers of surgical pathology. An occasional one has embraced the opportunity, but "where are the nine?"

I have always been grateful to the late John Caven who came back from von Recklinghausen's laboratory in 1889 bubbling over with enthusiasm. It was he who pointed out to me in no uncertain terms the value of pathology. Later it was my good fortune to study under that indomitable teacher Johannes Orth, the successor of Virchow. But to William H. Welch I am under an everlasting debt. For over 20 years, whenever in doubt, I had the rare opportunity of his advice and counsel. He was never too busy to look at my specimens and to spend hours if necessary

in making their meaning clear to me; and when something new was discovered he was really more pleased than if he had found it out himself. No other man in America has ever done as much to foster the spirit of laboratory investigation or afforded more encouragement to his pupils than Dr. Welch.

If one wishes to build a small cottage the simplest kind of foundation is sufficient. If on the other hand, he desires to erect a mighty structure deep foundations are essential. Pathology is the foundation of a surgical career.

You and I have learned much from the publications of other surgeons. Are we going to be sponges, merely assimilating the labors of others, or are we going to do our share in adding to the sum total of human knowledge?

The publishing of surgical papers without including the necessary pathological reports is like leaving out several chapters of an interesting novel. Those of you who have neglected the study of pathology should take it up at once. You will then learn the joy it brings. Often you will hardly be able to wait to see whether your diagnosis is correct or not. Day after day will unfold a new panorama and now and again you will have the delight of finding something brand new—something that has never been described before.

We are justly proud of the great strides American surgery has made. The technique in most of the surgical clinics is of a high order and the operative results excellent. Our College of Surgeons represents American Surgery. If America is to lead the world in surgery in the near future every member of this our surgical family must be thoroughly trained in the one thing still needful—surgical pathology.

## BRAIN ABSCESS FOLLOWING FRONTAL SINUSITIS

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A CASE of brain abscess following frontal sinusitis, which is one of a series previously reported from the Mayo Clinic (1), is selected for this report, because it illustrates excellently the classical symptoms of brain abscess and some of the problems met with in the surgical treatment of the disease.

Case 112525. The patient, a girl, aged 11, was examined in the clinic, November 6, 1919. Her tonsils and adenoids had been removed 7 years before; otherwise she had been in normal health. October 19, 1919, she was taken on a 150-mile automobile ride, and the next day she developed a coryza, which lasted 6 days, and was followed by headache, fever, and vertigo. Ten days after the onset a swelling was noticed below the right eyelid; this extended to the side of the face and forehead. October 28 the patient had a temperature of 102°. The swelling and pain persisted and November 5 a physician made an incision over the right eyebrow, evacuating pus.

Examination at the clinic revealed a large, smooth, fluctuating swelling over the forehead. Extreme cloudiness of the right frontal sinus, with some cloudiness of the left antrum, was shown by the roentgenogram. The pupils were equal in size and normal in reaction, with slight hyperæmia of the discs. No pus was found in the nose. The frontal sinuses could not be probed. The neurological examination was practically negative except for a slight ptosis of both eyelids. November 8, the patient suddenly went into general convulsions, which lasted 3 hours. Following this she was unable to move the left arm and leg, and the left side of the face. The right side was normal. Jacksonian convulsions of the left leg supervened on the same day; ankle clonus was marked on the left, and slight on the right. The Kernig sign was positive; the neck was rigid. In the afternoon of the same day there was a marked Babinski reflex on the left with the left arm and leg rigid. The patient was stuporous for the next 36 hours, with persistent left spastic hemiparesis. November 7, 10, and 17, the leucocyte count was 23,600, 25,800, and 12,000 respectively. Left paresis persisted and the patient's temperature varied from normal to 100° until November 23, when it returned to normal and remained so until the operation November 27, when a fluctuating mass in the frontal area was drained. The patient convalesced favorably except for a slight fever daily, with persistent weakness of the left side, until a second operation December 10. At this operation sequestra were removed from the right frontal bone. The dura

was exposed at one point but not perforated. The wound was drained with a gauze wick. The patient improved rapidly and in a few days was allowed to go home under observation.

January 8, the patient had several left Jacksonian convulsions. She was not unconscious during the attacks. The third operation was performed January 19, 1920. Sequestra were removed from the frontal bone and the dura was exposed over the right frontal area about 1.5 inches above the orbit. Again convalescence was satisfactory. The œdema of the eyelid disappeared, and the paresis improved, so that there was only a slight left-sided weakness. The patient went home, and from January 24 until March 1 she felt quite well, but still had slight left-sided weakness. She was able to roller skate and play, but had days of malaise, with loss of appetite. About March 1 she began to grow worse; headache and bulging of the area of the skull defect appeared, with daily fever and pain over the right frontal area.

March 19, the patient returned to the clinic. Examination at this time revealed choked discs of four diopters in both eyes and a slight weakness of the left side of the face, left arm, and left leg, with some exaggeration of the deep reflexes on the left. March 27, under ether, through the site in the frontal region where bone had been removed at the previous operation, the dura was exposed. On the insertion of a trocar and cannula, through the area which had become walled off by adhesions, into the right frontal lobe, an abscess was encountered about 2 inches below the surface under the outer part of this lobe. The walls of the abscess were firm; it contained about 3 ounces of pus. The abscess cavity was washed out with saline solution by inserting into it a small catheter attached to a syringe. Two rubber tubes made by cutting a No. 16 French male catheter were inserted into the cavity for drainage.

The patient made a rapid recovery and was able to leave the hospital on the sixth day. She gained in weight and strength rapidly. The paresis disappeared quickly, and the choked discs constantly diminished. One tube drain was removed 3 weeks after operation, and the second tube was gradually shortened. May 2, after the second tube had been so shortened that it just reached the outer edge of the abscess cavity, the dressings slipped during the night and the tube fell out. During the following 24 hours the symptoms returned, right frontal headache, malaise with clouding of the sensorium, slight fever, and increasing left-sided weakness. A curved forceps was very gently passed down the drainage tract and a catheter re-inserted. A quantity of pus was drained and the symptoms cleared up within 24 hours after the accident. May 12 hardly one diopter swelling in each eye remained. The second tube was removed May 20. The wound healed in a short time and the patient has been entirely well since.

Brain abscess is likely to develop in conjunction with osteomyelitis of the skull, and thorough drainage is advisable during the quiescent stage. In the case reported, during a period of 4½ months the patient presented symptoms of intracranial complications, but the signs of localized abscess did not seem sufficient to justify exploratory puncture of the brain until the appearance of the choked discs and the increasing left-sided paralysis, when a diagnosis of abscess was made and exploration advised.

The postoperative care, and especially the drainage, in deep-seated abscess of the brain must be looked after carefully. It is important that the drainage tubes be left in place instead of being withdrawn and replaced frequently. This point has been emphasized by Elsberg. The danger of too early permanent removal of the tubes is well illustrated by the accident in this case. Drainage tubes may be removed safely when the purulent drainage disappears and only a slight ropy mucilaginous material exudes. This stage may be reached in from 1 week to 3 months after the operation.

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# DEPARTMENT OF TECHNIQUE

## NITROUS-OXIDE–OXYGEN ANALGESIA IN MAJOR OPERATIONS

### A Further Advance in Anociation

By G. W. CRILE, M.D., F.A.C.S., Cleveland

HERETOFORE, in considering the advantages of local anæsthesia, alone, as compared with general anæsthesia, alone, the surgeon has been placed in the difficult position of choosing between two evils: he must either operate with his patient under complete surgical anæsthesia, knowing that in grave risks the interference of the anæsthetic with the internal respiration alone, disregarding all other unfavorable factors, would often cause death, not on the table, but later. Or, if the surgeon wished to escape this horn of the dilemma, he must discard general anæsthesia altogether and adopt local anæsthesia alone as the method of his choice. In this case, many of the patients would go through the operation without pain, a large number with pain, and all of them with great mental anxiety and distress, the harmful effect of which in grave risks might cause death.

Moreover, bad risk patients cannot endure even the mild degree of suboxidation due to surgical nitrous-oxide anæsthesia. The types of cases of which this is particularly true are starved and toxic cases—cases of obstruction of the pylorus, of cancer of the large intestine and of diseases of the gall-bladder and common duct. This danger is especially manifest in cases of severe exophthalmic goiter. In such cases, without question, even the most guarded nitrous-oxide-oxygen anæsthesia is harmful to the extent to which it interferes with the internal respiration, especially the internal respiration of the liver, the myocardium and the brain.

Now if a bad risk patient cannot safely be carried through an operation under inhalation anæsthesia, and if, on the other hand, he cannot safely be operated upon under local anæsthesia alone, then what course remains for the surgeon?

In the effort to solve this problem, two schools have developed: one consisting of those who believe in local anæsthesia exclusively in bad risks, and for most operations; the other, and larger school, comprising those who believe in general anæsthesia for all patients, and consequently reject those cases in which, according to the experience of the surgeon, the margin of safety appears to be too narrow for safe operation under a general anæsthetic.

Believing that neither of these schools were attaining the most desirable results from the standpoint of the patient's comfort and safety, we sought in our clinic to adopt a course which combines the advantages and avoids the disadvantages of each; that is, to employ analgesia combined with local anæsthesia.

Since 1880, when Klikowitsch successfully employed nitrous-oxide-oxygen to lessen the pains of labor, this form of analgesia has been familiar to obstetricians; and during later years it has been extensively used by dentists. Dr. Walter Evans and others have advocated the use of nitrous-oxide-oxygen analgesia in minor operations, especially in operations on the nose and throat and in certain major operations.

In our clinic we first employed nitrous-oxide-oxygen analgesia for bad risk cases of exophthalmic goiter and have gradually extended its use to bad risk cases of all kinds until now it is employed in approximately 90 per cent of all our cases.

It happens to be the remarkable property of that degree of nitrous-oxide-oxygen anæsthesia which is known as analgesia that the patient is freed to a considerable extent from the sensation of pain, yet retains his intellectual control, and at the same time is entirely freed from his emotions. One could undoubtedly say to a patient under analgesia: "You will die in a few moments," and this would mean to him merely the statement of a fact in which he was not particularly interested since by analgesia he has been rendered incapable not only of expressing, but even of feeling an emotion. In brief, analgesia completely separates a patient from his emotions, affords him great relief from the sensation of pain, and at the same time allows his brain to function sufficiently to aid him in "carrying on." Of paramount importance, however, is the fact that in analgesia the internal respiration is not in the least impaired.

The state of analgesia may be continued for the largest operation, even with very sick patients without any bad results. Because of these observations we have been collaborating with Miss Hodgins and other members of the anæsthetic staff in an endeavor to perfect the technique of the administration of analgesia plus local anæsthesia as the greatest aid to surgery of which we can at the present time conceive, since by means of it the patient undergoes a pleasant experience and a shockless operation, and above all, because he passes through the operation not only with his internal respiration unimpaired, but with all his factors of safety undiminished.

The chief anæsthetist of Lakeside Hospital, Miss Agatha Hodgins, offers the following practical notes:

It is one thing to have decided upon analgesia as the most satisfactory form of anæsthetic; it is quite another to administer analgesia properly. To accomplish this requires great versatility, a quick and ready understanding, and a sympathetic attitude toward the patient. The ideal anæsthetist will be able not only to give the patient confidence in himself, but confidence in the anæsthetist and the operator as well. Skill in handling psychical and personal factors are as necessary to the anæsthetist as skill in gauging the correct amount of gas and oxygen which will assure pure analgesia without intoxication. It takes at least 6 months' training under an expert anæsthetist who can give good analgesia before the novice will have developed all her own resources.

The anæsthetist must be carefully trained to recognize promptly the approach of the different zones of anæsthesia. In true analgesia, the patient is in a state of mental indifference which is manifested by a placid expression. It is possible to maintain mental contact with the patient, and to get responses from him. It must be borne in mind, however, that although the patient still has control of his mental faculties, nevertheless the brain processes are considerably retarded, so that response will be retarded accordingly. In true analgesia the voice is thickened. Therefore, when there is a thickened voice and a slow response, it is evident that the dosage of gas should not be increased, for the patient is on the border-line between analgesia and anæsthesia, and will readily pass into the state of anæsthesia.

Perhaps the best index to the comfort of the patient and the degree of analgesia is the expression of the eyes, which should be closely watched by the anæsthetist. If the expression of the eyes is quiet and undisturbed, and the eye movements are rather slow, the anæsthetist may be assured that analgesia is satisfactorily established. A more rapid movement of the eyes combined with a worried expression may indicate pain, and hence the necessity of slightly increasing the dosage of gas, possibly to the momentary establishment of anæsthesia. On the other hand, these indications may be a warning that the patient is coming out of the analgesia.

The rate of respiration is of the utmost importance. An increased rate almost uniformly indicates pain. An attempt to move may or may not indicate pain, since in analgesia the patient to some extent retains control of his mental powers, and the brain may be aiding the body by shifting it to a more comfortable position. For example, if there is traction, the patient may be adapting his muscles to the traction, thus diminishing the pressure. When there is pressure, the patient usually holds his breath, in which case oxygen alone should be administered, and the nitrous oxide stopped for a moment. If pain is clearly indicated, the analgesia should be increased to anæsthesia, but—and this is very important—only temporarily, until the acute pain stage is passed. The patient should be brought back as quickly as possible to mild analgesia before he has had the chance to pass into the second stage of anæsthesia.

In the course of an operation it sometimes becomes necessary to change the position of the patient. In such a case, the necessity for the change should always be explained to the patient in order that his retarded mentality may not be disturbed by it. It is an important part of the anæsthetist's task, in fact, to make the unusual seem usual. The following illustration will perhaps elucidate this point. In removing a large goiter, traction and pressure are almost unavoidable. At this point, the patient's eyes usually indicate pain and bewilderment; but if the anæsthetist remarks: "You put on a new collar this morning. It is a little tight," the patient will at once seem satisfied and the expression of the eyes will become comparatively calm.

The advisability of talking to the patient during operation is a debatable question. Here the personality of the anæsthetist and his ability to form a correct estimate of the personality and the needs of the patient, and hence to form a sympathetic mental contact, will count for much. The right amount of conversation will be an aid to the patient; too much will disturb him, for it must be remembered that the power of response is so retarded that it is difficult for him to answer; and moreover, that in operations on the neck, talking on the part of the patient is interfered with. Though this is not true in all cases, it is frequently advisable for the operator to speak to the patient when he comes in, particularly if the patient has expressed any doubt as to whether or not the surgeon of his preference is to perform the operation.

Under analgesia, the sense of hearing seems to become altered. The patient often speaks much louder than is necessary but he is also extremely annoyed by whispering. This fact should constantly be borne in mind by all those attending the operation. Any remark that is made should be in a normal speaking voice, for whispering invariably leads the patient to think that something is going wrong.

As to the appreciation of time and space under analgesia, the sense of each is exaggerated. This is particularly noticeable when taking a patient under analgesia into an elevator, for he seems to feel the drop and rise more than is normal; and therefore, when it is necessary to take such a patient in the elevator, the anæsthetist should explain what is happening as simply as possible. All explanations should be simple, should relate whatever is happening to everyday occurrences which the patient knows will not harm him.

The operator should also co-operate with the anæsthetist in guarding the patient against pain by warning the anæsthetist that a painful procedure is about to take place. This is particularly true in dislocating tumors, and whenever unavoidable traction is produced. During this period the patient should be momentarily advanced to the stage of anæsthesia.

It will be evident from the above discussion that an anæsthetist who can satisfactorily administer analgesia must possess true sympathy, coupled with that type of intellect which can successfully conduct a debate, an intellect which at the outset forms a correct estimate of the

problem in hand, the disease plus the personality and intellect of the patient. It is essential also that as the operation progresses the anæsthetist accurately gauge from moment to moment the sensitiveness and control, or lack of control, on the part of the patient. These are, indeed, rare qualities, but an anæsthetist who possesses them has an opportunity for immeasurable service to surgery.

Our record of 1518 adminstrations of analgesia includes the following major cases:

1107 thyroid operations including 360 thyroidectomies and 389 ligations.

149 abdominal operations, including 16 upon the large intestine, 26 upon the gall-bladder, 22 upon the stomach, 8 exploratory laparotomies.

The mortality in this series was 0.59 per cent. These figures include an unbroken series of 443 thyroidectomies and ligations without a death.

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# TUBERCULOUS ULCER OF THE ANTERIOR VAGINAL WALL WITH RESECTION OF ULCER[1]

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TUBERCULOUS ulceration of the vagina is only occasionally observed. It may be the sequel to extensive peritoneal and pelvic tuberculosis. Rarely, however, is the vagina the only pelvic structure involved, and to this group alone shall we refer. Those cases which have been reported show in nearly every instance an associated or pre-existing pulmonary tuberculosis.

Namias (1) in 1861 reported a diffuse tuberculous ulceration of the vagina and bilateral pulmonary tuberculosis, in a prostitute.

Klob (2) in 1864 reported a case showing at autopsy, tuberculosis of the lungs, tuberculous ulceration of the intestine, tuberculosis of the liver and tuberculous ulceration of the vagina.

Deschamps' (3) patient, 25 years old, showed tuberculous ulceration of the vulva and vagina, tuberculous ulcer of the hand and bilateral pulmonary tuberculosis.

Pitt (4) in 1887 reported an interesting case of a small ulcer of the vagina and I shall present his report verbatim.

There is a single irregular ulcer one-sixth inch across, with loss of mucous membrane, one-fortieth of an inch deep, situated three-fourths of an inch from the os uteri on the anterior wall of the vagina. The floor is irregular, the margin at one spot is undermined. When fresh the margins were extremely congested and swollen, but there was no infiltration and no signs of adjacent tubercles. The ulcer was fairly recent and not healing.

Ulcers in the upper part of the vagina, excluding malignant and traumatic, are uncommon. None are recorded in the transactions of this society.

The patient in whom this ulcer was found had been in the hospital in bed for 4 months previous to her death, suffering from phthisis. Postmortem. Numerous tubercular ulcers were found in the intestine and larynx.

Zweigbaum (5) in 1888 reported a case of old pulmonary tuberculosis with associated tuberculous ulceration of the vulva, vagina, and portio vaginalis.

Havas (6) in 1897 reported a case of tuberculous ulcer of the introitus vaginæ.

I present the following case as one of special interest from a clinical, pathological, and operative standpoint.

L. S., age 37, married, admitted to Harper Hospital March 22, 1920. For four years the patient has complained of recurrent attacks of dull aching pain in the lower abdomen, and during the past 6 months has complained of irregular vaginal bleeding. For the past 6 weeks this bleeding has been slight in amount but constant. She has had also increased frequency of urination during the day time and occasional smarting sensation in the vagina. The patient, her husband, and a son, 8 years of age, have been in the tuberculosis department of the Herman Kiefer Hospital for 2 years. The patient and her husband are suffering from pulmonary tuberculosis, and the son from tuberculosis of the right hip-joint. The husband on careful examination has shown no evidence of urogenital tuberculosis. Blood Wassermann tests were made on both the patient and her husband, a positive reaction being reported in each instance. From their

[1] Read before the [illegible]

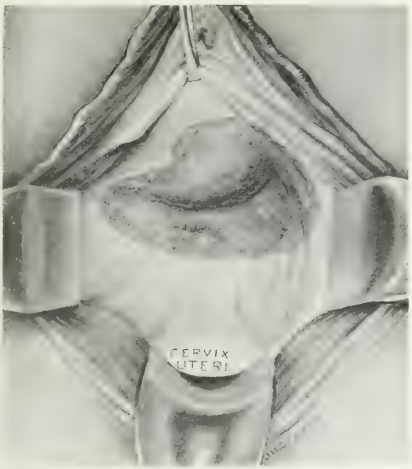


Fig. 1. Tuberculous ulcer of anterior vaginal wall (natural size). The ulcer measures approximately 6 by 4 centimeter. The margins which are firm are elevated about 2 millimeters above the base. The latter presents the typical applejelly appearance of a tuberculous ulcer and on manipulation fine bleeding points are visible.

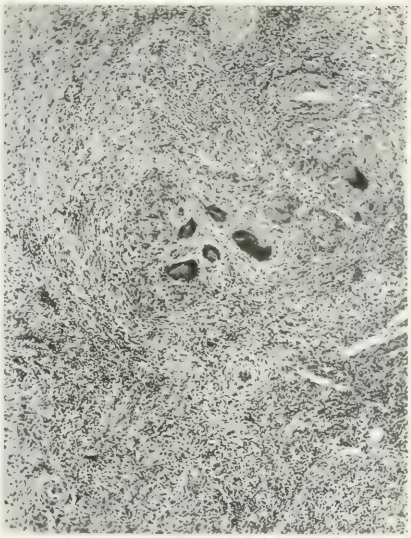

Fig. 2. (Photomicrograph approximately 300 diameters.) This section taken from the margin of the ulcer presents the typical picture of active tuberculosis. The giant cells in this section are especially numerous.

histories, however, we have been unable to obtain any clinical evidence of lues. Relying solely upon the positive Wassermann reaction both had been given salvarsan and mercury. The patient had typhoid fever at 16 and pneumonia at 25. Her menstrual history has been perfectly normal. She was operated on 16 years ago for a right ruptured extra-uterine pregnancy. She gave birth to a full-term child 13 years ago, the child living, however, but 3 days. She had a second child born 8 years ago. Both labors were normal. A therapeutic abortion for a 3 months' pregnancy was performed in June, 1919.

General physical examination of the patient on March 23, 1920, shows moderately active bilateral pulmonary tuberculosis.

Abdominal examination is negative, except for slight pain on deep palpation over the left lower quadrant.

*Vaginal examination.* The outlet is marital with some relaxation. There is a scant bloody vaginal discharge. The urethral orifice is normal. On introduction of the examining finger into the vagina it immediately comes in contact with a roughened area on the anterior wall. Manipulation of this causes some bleeding, but the patient suffers very little discomfort. The cervix is normal in size, points backward, and is perfectly smooth. The fundus is normal in size, in anteposition, but movement is restricted. The appendages on the right side are free. Occupying the left fornix is a small cystic mass approximately 5 centimeters in diameter, which is movable but tender on manipulation.

On examination of the vagina with the speculum an irregular punched-out ulcerated area (Fig. 1) measuring approximately 6 by 4 centimeters is found on the anterior vaginal wall beneath the base of the bladder and extending a slight distance downward along the urethra. The margins of the ulcer are hard and elevated about 2 millimeters above the base. The latter presents the typical apple jelly appearance with fine bleeding points on manipulation

Smears taken from the ulcer and examined with the dark field illumination were negative for spirochætæ. Smears were also negative for tubercle bacilli.

The clinical laboratory findings are as follows:

Urine examination (catheterized specimen) shows specific gravity 1,012; acid; pale color; cloudy; no sugar; no indoxyl; no bile; slightest trace of albumin. The centrifugated sediment which is slight contains a few squamous epithelial cells, numerous pus cells, but no casts or blood. Examination for tubercle bacilli was negative.

Blood examination showed hæmoglobin 70 per cent (Talquist); red cells 3,700,000; white cells 14,000.

Differential white cell count: Polymorphonuclear cells, 74 per cent; small mononuclear cells 6 per cent; large mononuclear cells, 17 per cent; transitional cells, 3 per cent.

A blood Wassermann showed a 4+ reaction. (There were no clinical manifestations of lues.)

Roentgenological report by Dr. William A. Evans. Plate of the chest in the posterior position shows no evidence of lower lobe pathology nor any evidence of pleuritis. There is an increased deposit at the hilus on both sides and accentuation of the linear markings. There is evidence of a bilateral, parenchymal infiltration, this being seen more especially opposite the first and second interspaces on the right side, and opposite the first interspace on the left side. There is an area of increased density opposite the middle

portion of the right hilus and also opposite the fifth interspace on the right side. The appearance is that of a well-resisted parenchymal tuberculosis.

Cystoscopic examination shows the bladder mucosa normal in appearance except for some reddening over the trigonum. Both ureteral orifices are normal. There is no evidence of tuberculosis.

April 8, 1920. Under gas anæsthesia two small wedge-shaped pieces of tissue were removed from the margins of the ulcer. These, on microscopical examination, presented the typical picture of active tuberculosis (Fig. 2).

Before attempting excision of the ulcer we wished to ascertain what curative results might be obtained by use of the roentgen-ray or radium. Before so doing, however, we decided to relieve the patient's abdominal symptoms.

*Abdominal operation, April 14, 1920, median incision.* Examination of the pelvic structures shows the presence of a left cystic ovary 6 centimeters in diameter and an adherent tube. The right tube is missing. The right ovary and uterus are normal. Examination of the pelvic structures shows no evidence of tuberculosis. Scattered over the head of the cæcum, however, are a few discrete and confluent tubercles. The appendix shows only slight chronic thickening. Examination of the other abdominal viscera shows no gross evidence of tuberculosis. The appendix and left tube and ovary were removed. On microscopical examination the tube shows chronic salpingitis, the ovary a corpus luteum cyst, and the appendix a chronic catarrhal inflammatory process. No tuberculosis is evident at any point.

May 11, 1920. Dr. J. E. King subjected the ulcer to a maximum dose of roentgen-ray.

May 29, 1920, Dr. J. E. King inserted 50 milligrams of radium into the vagina for a period of 5 hours. The patient was discharged from the hospital on June 1, 1920.

July 15, 1920, a second similar-sized dose of radium was again given.

September 12, 1920, the patient was again admitted to the hospital.

The roentgen-ray and radium had shown no appreciable effect on the ulcer and we decided to attempt excision.

*Operation September 7, 1920. Dilatation and curettage, excision of ulcer.* Dilatation and curettage were performed, but only a small amount of curettings were obtained.

In order to facilitate removal of the ulcer and also to minimize damage to the bladder, it was deemed advisable to make a vertical incision directly through the ulcer. The line of demarcation between the base of the ulcer and the underlying fascia was more definite than we had anticipated. The line of cleavage thus obtained made simple the removal of both portions of the ulcer, leaving a perfectly clean-cut wound. The margins were then approximated with a continuous locking suture of No. 2 chromic catgut. Three stay sutures of the same material were employed. Catheterization showed the bladder uninjured. Following operation catheterization was ordered every 8 hours until the seventh day to avoid any strain on the vaginal wall. Convalescence was slow but uneventful. There was some breaking down of the wound at the left upper angle but this soon healed by granulation.

*Histological report.* Examination of the uterine scrapings shows a perfectly normal endometrium. Further sections from the ulcer show the same picture of tuberculosis as previously reported (Fig. 2).

December 11, 1920. The wound has healed perfectly and the patient is free from any discomfort. The bladder condition is rapidly clearing up.

February 1, 1921. This patient returned today for examination. I found a recurrence of the tuberculous process on the anterior and left vaginal walls with extension outward toward the left labium minor, in close proximity to the external meatus. The patient complains of burning pain in this area on urination.

June 1, 1921. Some improvement has resulted from frequent applications of the Kromayer light.

The salient features of this case are the following:

1. The tuberculosis seemed to be limited to the lungs, the head of the cæcum and the anterior wall of the vagina.

2. The anterior vaginal wall was the only pelvic structure involved in the tuberculous process.

3. There was no evidence of urogenital tuberculosis in the husband.

4. The involvement of the vaginal wall appears to have been hæmatogeneous in origin.

5. It was possible to resect the ulcer with subsequent healing of the wound.

In conclusion, I wish to express to my resident, Dr. O. C. Foster, my appreciation for much of the clinical data obtained and to Dr. C. I. Owen, of the pathological laboratory, for assistance in a study of the literature.

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# A METHOD OF CRANIOPLASTY

## Using as a Graft One-half the Thickness of the Bony Part of a Rib

By MAX BALLIN, M.D., F.A.C.S., Detroit, Michigan

A BONY defect in the skull shows no tendency toward repair. Though the periosteum, the cancellous diploe between the two tables and the dura all have osteogenetic powers, the periosteum soon grows down over the edge of the defect and becomes adherent to the dura. This cicatricial union prevents or limits any callus production. The only exception is when the wound has been left open for a considerable length of time. In some of these cases the skull defect has been noted "as becoming smaller," presumably because the granulations prevented the periosteum-dura cicatrix and the accompanying infection was a stimulus to osteogenesis.

The exposed dura, meninges, or brain substance soon become adherent to the overlying skin and this is followed by a variety of symptoms. These, known only vaguely before the war, have been seen so constantly and frequently during the last few years that they have been grouped by some[1] into a "trephine syndrome."

They are: (a) headaches, constant and severe, often associated with melancholia or perversion of the disposition, emotional disturbances, insomnia, etc. They may be made worse by weather changes, sunlight, heat, exertion, etc. (b) Unpleasant sensations of vertigo or nausea, especially when suddenly changing position, stooping over, turning the head quickly, etc. (c) Inability to tolerate external vibrations, as a moving train or shaking automobile; sometimes there is dizziness on walking or inability to stand the flicker of a movie film. (d) A sense of insecurity, due to the constant dread of further injury, often preys on the patient's mind. "The existence of a loss of substance preoccupies the patient so that he lives in a continued state of inquietude and brooding."[2] Janssen[3] in a series of 323 collected trephined cases, found some or all of these symptoms present in 98. Warstat[4] in 56 observed cases found only 4 which showed no changes of this nature.

Epilepsy is present in 10 per cent of trephined wounds (Janssen[5]). Holz[6], in 120 brain wounds, found 11 cases of epilepsy: 9 were in wounds of the arm-leg motor areas, 2 were extensive occipital wounds. It generally develops 2 to 3 months after the injury.

Cranioplasty relieves most of these symptoms, and the relief is generally immediate. Some have advised waiting 6 to 8 months before repairing the defect, believing that there is danger of latent infection before this. There are advantages in doing the cranioplasty early. The scar process is interrupted so many months sooner and epilepsy is prevented. Gilmour, Hotz, and others

[1] Nesselrode. Surg. Clin., Chicago, 1918, iii, 789.

[2] Montpelier méd., 1918, 55.

[3] Quoted in editorial. Ann. Surg., 1919, lxix, 61.

[4] Deutsch. med. Wchnschr., 1918, p. 112.

[5] loc. cit.

[6] Beitr. z. klin. Chir., 1915, xcviii, 592.

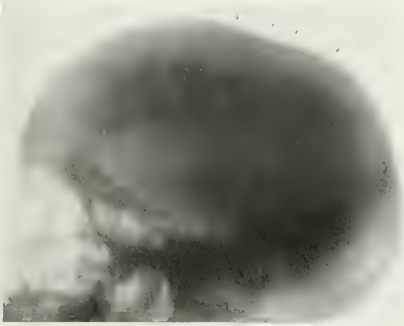


Fig. 1. Rib graft in place in the skull 7 months after transplantation.

Fig. 2. Incision in midaxillary space to expose sixth and seventh ribs. Also note outline of skull defect.

Fig. 3.

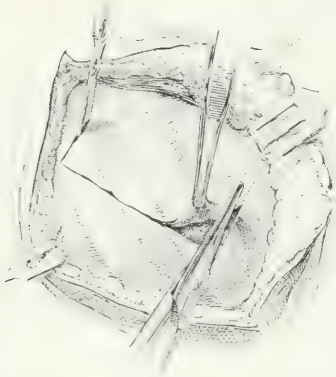
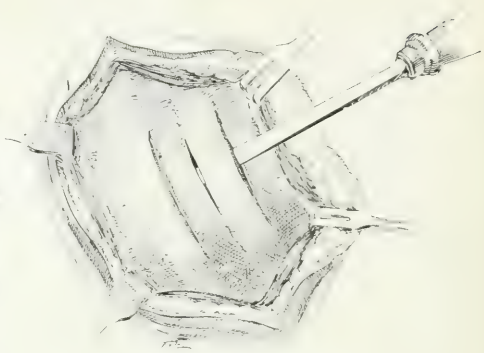


Fig. 4.



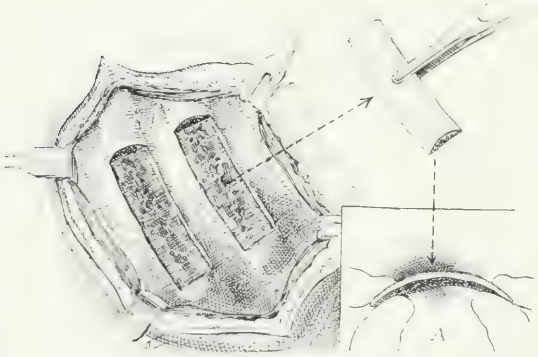


Fig. 3. Quadrilateral piece of fascia excised from pectoralis fascia somewhat larger than skull defect.

Fig. 4. Rib exposed by pushing the muscles aside; periosteum incised along upper margin of rib and the outer half of rib chiseled off with a narrow, thin-bladed chisel, splitting the rib gradually.

Fig. 5. Such grafts may be taken from two or three neighboring ribs. Upper insert shows graft. Lower insert shows flexibility of graft.

Fig. 5

advocate the secondary closure as soon as the wound has healed, *i.e.*, within the first month after injury.[1]

METHODS

Before the general application of the free autogenous transplant various foreign substances were used to bridge the defect. These included plates of gold, silver, ivory, horn, mica, rubber, cork, celluloid, and paraffin. They were all open to the same objection as all heterogeneous grafts, i.e., delayed suppuration, frequently necessitating their removal long afterward. These methods now have merely an historical interest.

Next was the Koenig-Mueller skin-osteo-periosteal flap. This method consisted in the exchange of two pediculated flaps. One taken from over the defect contained only the scalp covering the defect. From the neighborhood a second flap was formed with a pedicle in the opposite direction to that of the first flap. This second flap contained scalp, pericranium, and outer table chiselled off carefully from the diploe. These two flaps were exchanged, so that the bone-containing flap

Fig. 6.

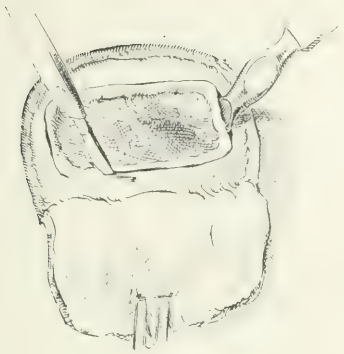
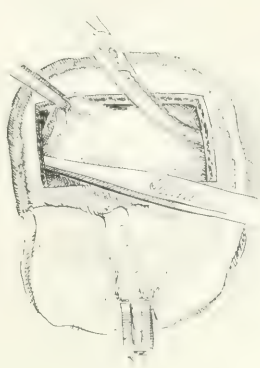


Fig. 7.



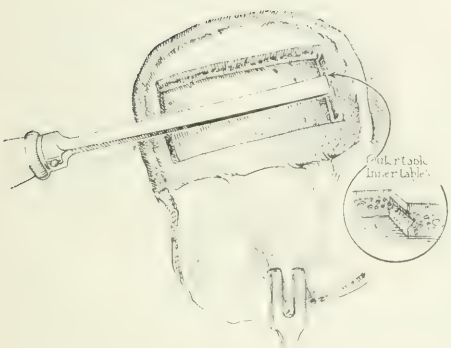



Fig. 8.

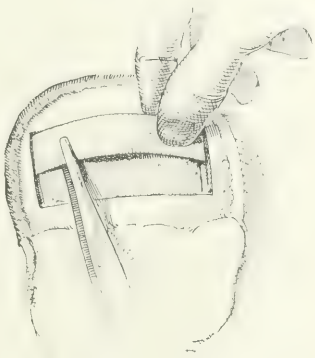


Fig. 9.

Fig. 6. Skull defect exposed by turning down quadrilateral flap and dura separated from periosteum around the edges of the defect.

Fig. 7. Fascia graft placed over exposed brain and pushed underneath bone edges.

Fig. 8. The slots are prepared for the reception of the bone grafts by driving chisel into the diploe. Insert shows the slot completed.

Fig. 9. The elastic bone graft inserted in slots to repair defect.

covered the defect while the boneless flap took the place of the former. The disadvantages of this method are that there is considerable hæmorrhage from the scalp and the diploe and the exchange of the flaps causes buckling of the pedicles. Chiefly, however, the spongiosa is laid directly upon the dura, which tends toward callus formation and causes subsequent cortical irritation. We have used the Koenig-Mueller method quite successfully, especially in Army work, sometimes combining it with transplantation of a flap of fascia lata to prevent adhesions between the brain and graft.

The objections mentioned to the Koenig-Mueller method led to the Hacker-Durante modification. Here a flap, consisting of periosteum

and outer table, was made near the periphery and then the pedicle twisted so that the periosteal surface lay next to the dura. The flap was not easy to make, the repeated hammering often produced cerebral concussion, and these flaps were liable to gangrene.

The French use cartilage grafts, introduced by Morestin. The advantage is that cartilage is more easily fashioned to the circumference of the cranium than is bone. Though the immediate results are good, there have been several instances recorded of complete or partial absorption of the graft, leaving the patient with the old dreaded sense of insecurity.

Leriche. Lyon chir., 1917, Oct. In one case operated on 36 days before, in one 1 year previously, the cartilage was replaced by connective tissue. In two other cases, after 5 months, the cartilage softened and did not give the same protection that bone did.

Wilson. Ann. Surg., 1919, lxix, 230. Cartilage graft inserted April 12. On May 15 the graft was "not as firm as it had been and there was some bulging on coughing."

Autogenous bone transplantation is now the method of choice in repairing cranial defects. The bone is most often taken from the tibia, but grafts have also been used from the rib, sternum, trochanter of the femur, wing of the scapula and spine of the ischium. For the reception of the graft, the outer table is beveled off for one-half inch at opposite edges of the defect and the graft held in place by sutures through holes bored through the inner table (Morrison), or by a lattice of sutures across the periosteum, or the ends of the graft are tucked in between the inner table and the dura (Nesselrode). Using one-half the thickness of a rib as a graft was first suggested for bone grafts in defects of the mandible (Gallie and Robertson).

Through the vicissitudes of opinion regarding just what happens to bone transplants, most observers agree that their fate depends upon the rapidity of blood supply plus the presence of osteoblasts (McWilliams[1]). Osteoblasts on and near the surface, in a position to absorb nutriment from the bathing lymph, are capable of living and proliferating. "At the end of ten days, proliferation of these osteoblasts, on the periosteal and endosteal surfaces, is well established. The circulation is re-established by the ingrowth of new blood vessels into the mouths of the haversian systems. This takes place with extraordinary rapidity. In small porous transplants it is complete in 2 weeks." (Gallie and Robertson.[2]) The rapidity with which these changes occur depends upon the size and density of the graft and the number of surviving osteoblasts on the surface. In large or dense grafts, requiring deeper or more difficult penetration for the blood vessels, absorption and replacement are necessarily slow.

These considerations have led Gallie and Robertson to assert that half a rib is the graft of choice except where support is wanted. They used it in repairing a loss in continuity of the mandible. Carter[3] has used a similar graft in rhinoplasty after the Italian method. Half a rib was transplanted into the arm and two weeks later an arm flap, with the contained bone, was turned into the nose defect. Brown[4], in Australia, reported a series of cases in which half-thickness rib grafts were used for cranioplasties, but his method differs from ours in many points, which seem to render the method used by us preferable. We operated upon our first cases in 1918 without knowing of Brown's article.

An ingenious method, recently described by Kreider[5] may be advantageous in certain cases. While operating upon a very recent, depressed fracture, two large bone fragments were removed and inserted subcutaneously in the hypochondrium for preservation. Seven weeks later, after infection had well subsided in the skull, the fragments with some adherent fat were taken from the abdominal pocket and re-implanted into the cranial defect, a good result ensuing.

The technique of our method is as follows:

1. We procure the graft by exposing one or two ribs on the side of the thorax through a flap incision. We use the sixth and seventh ribs, the middle of the incision being about the mid-axillary line (Fig. 2).

2. A quadrilateral piece of fascia is excised from the pectoralis fascia, somewhat larger than the skull defect to be covered (Fig. 3). This fascia is kept in a warm saline solution.

3. The rib is exposed by pushing the muscles aside. The periosteum is incised along the upper margin of the rib; then the outer half of the rib is chiseled off, leaving the inner half intact upon the pleura. This is done by chiseling along the upper margin with a narrow, thin-bladed chisel, splitting the rib gradually for the required distance (Fig. 4). After the rib is split throughout the length of graft desired, the graft is removed by biting through each end with strong bone scissors. The splitting need not be carried down to the lower or inferior edge of the rib (as figure shows erroneously). A very little caution will avoid entering the pleura.

[1] Surg., Gynec. & Obst., 1916, Jan.

[illegible]

Grafts can be taken from two and three adjoining ribs, if necessary for covering a large skull defect (Fig. 5). These grafts are also kept in saline solution, and the chest wound is closed in layers.

4. The skull defect is exposed by a quadrilateral flap. The skin is carefully dissected from the underlying adherent brain or dura, though the minute dissection of all scar tissue from the brain, advised by some, is not deemed necessary. The dura is separated from the periosteum around the edges of the defect and the edge of the bone taken away for one-quarter inch around the entire periphery, using a gnawing bone forceps or small chisel (Fig. 6). Irregular defects are made regular in outline to receive the grafts properly. The fascia transplant is next placed over the exposed brain, pushed underneath the bone edge and smoothed out. Sutures are not needed, in our opinion, to keep this fascia graft in place (Fig. 7).

5. The bed for the reception of the bony graft is now prepared as follows: On opposite sides of the defect the outer and inner tables are separated by driving the chisel lightly between the two, along the exposed edge of the diploe. With only a few strokes of the chisel a short slot is thus easily formed in the cancellous middle layer of the cranium (Fig. 8).

6. The rib grafts are put in place by simply inserting each end in the prepared slot. If the rib is made a trifle longer than the defect it will tend to curve outward, away from the brain, and will keep its position in the slot firmly because of its elasticity (Fig. 9). Two or more grafts can be placed side by side to bridge a large defect.

7. The skin flap is turned back and sutured in place.

## ADVANTAGES

1. Both fascia and bone are obtained from the same location. In all other methods the fascia graft is obtained through a separate incision in the thigh or abdomen. Besides, the pectoral fascia, light, areolar, with fat adhering on both surfaces, is a better protection against adhesions than is the firm, fibrous fascia lata.

2. The rib seems to have a natural line of cleavage in its center. As the pleural half of the rib is left *in situ*, there is rapid regeneration and no rib defect results.

3. A graft consisting of only half the thickness of the rib has a considerable degree of springiness and elasticity to it (see Figure 5, insert). This allows it to be easily molded to the skull without the necessity of sawing half way through the graft at short intervals (Albee), as must be done with denser and thicker grafts to bend them. This impossibility of easily shaping bone grafts is the chief reason why Chutro and others prefer cartilage grafts. Our half-rib graft has this advantage over the cartilaginous graft without the disadvantage of being resorbed early.

4 The wedge-shaped slot fashioned in the diploe for its reception requires only a few strokes of the chisel. There is no bleeding as in exposing a wide area of the diploe, no foreign material is needed for fixation and the graft can be set in with curve enough to separate it from the underlying brain.

5. Brown's method does not include the fascia flap, which we think is important for preventing adhesions between graft and brain. He keeps the rib graft in place by a lattice work of sutures, which are difficult to take in the periosteum or galea and not comparable to the ease of fixating the grafts in slots.

Since writing this article, in the last number of *Archives of Surgery* (vol. 1, No. 3, 428), Dr. Leo Eloesser recommends rib-grafting for the repair of defects in long bones and mentions that "the rib is particularly well adapted for filling in cranial defects. The convexity fits in well with the curve of the cranium and gives an excellent cosmetic result." He gives no special technique, however, and his cases reported are all transplantation into long bones.

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

Regular Meeting, Held December 3, 1920, Dr. William Fuller, Presiding

### ACUTE PARTIAL ENTEROCELE

Dr. Charles F. Sawyer read a paper entitled "Acute Partial Enterocele." (See page 38.)

### DISCUSSION

Dr. Coleman G. Buford: I would emphasize particularly the importance of a point and the treatment of it, quoted by Dr. Sawyer in connection with the subject of partial enterocele. I refer to enteroceles occurring into drainage tubes used in the abdomen. He quotes two cases where this occurred, in which the glass drainage tubes had to be broken in order to liberate the gut. It would seem that my experience is worthy of recording.

About 1911 I attempted to do away with gauze drains and gauze wrappings for tubular drainage in the abdomen. I realized that there was danger of herniation of the gut and omentum into the fenestrations of tubes, and I, therefore, chose tubes with the distal ends closed and having very small lateral fenestrations. Several months passed without any difficulty, when upon withdrawing one of these tubes, I brought out with it a loop of intestine and found that there were three or four nipple-like projections of intestine within the drainage tube. These had become œdematous and it first seemed impossible for me to get them out without breaking the tube, but I was able to remove them without serious damage to the peritoneum by making gentle tractions. In fact, I was surprised to see how easily these came out. About 6 months later this accident occurred again, but on this occasion the tube was literally filled with protrusions of gut, each of which was swollen. I remembered my first experience and applied the same method of gentle, but slow traction, and released all of these without its being necessary to break the tube.

I will say, by the way, that I have seen only one partial enterocele following an operation. That occurred in the service of Dr. Fenger at Mercy Hospital about 1896 or 1897. He laparotomized a man who showed a permeable bowel, but persistent vomiting and abdominal distention. Several days after the operation, the wound was opened and a partial enterocele between sutures in the line of the abdominal incision, was found. His symptoms were relieved and the man recovered.

### RESULTS IN THE OPEN TREATMENT OF FRACTURES

Dr. Joseph Smith, Wausau, Wisconsin, read paper entitled "Results in the Open Treatment of Fractures." (See page 45.)

### DISCUSSION

Dr. William Hessert: One of the last statements made by the essayist was that it was not good surgical practice to leave in a foreign body. I would like to ask him, when he closes the discussion, to tell us what his reasons are for making that statement. Personally, I leave the foreign body in, and do not take it out unless there is infection. Roughly speaking, in 100 cases in which I have used foreign bodies, I have had 2 cases of infection, one of the femur, and one of the fibula. In the case of the fibula the plate had to be taken out on account of infection, and in the femur the plate was taken out because a sinus developed.

Aside from these cases, I have made it a practice to leave the foreign body in. I have had no complaint on account of its weight. None of these cases has had the plate removed by other surgeons, so far as I know.

Dr. Emmanuel Friend: I would like to ask Dr. Smith how many cases of infection he has had in the 33 cases in which he used Lane plates. I am sure, my results from the use of Lane plates are not as good as his. A great many of them have had to be taken out.

Dr. Charles E. Kahlke: I would like to ask Dr. Smith as to the functional results obtained in the cases of Colles' fractures. We see too many of these cases coming with severe deformity, but the greatest distress seems to be to abandon fixation rather than have bony deformity.

Dr. James M. Neff: This is the best paper I have heard on the surgery of the bones for a long time. Dr. Davis, who is present this evening, knows that in France we had a great many simple fractures of the bones that were plated. We used the Lane technique throughout and very rarely had infection. After plating these fractures we were able to send the patients over to England in a short time, instead of keeping them in France for a long time; we plated the [illegible] fractures, put the limbs in casts and sent the

patients over to England inside of 2 weeks. Those we did not plate had to be kept in France for several weeks. We plated every bone in the body, the clavicle, the long bones, the humerus, both bones of the forearm, the tibia, the fibula, etc. We have done a great deal of plating. We have plated the clavicle in a number of cases and have resorted to ring in some. In the latter I have adopted the method which I described in a recent paper on wiring of bones, particularly those fractures where there are small fragments. For instance, in the cases of Colles' fracture, where the fracture is produced by falling on the back of the hand, with a displacement forward and upward in some of these it is hard to reduce the deformity. We have had some of these cases where we have opened the parts and put in wire in accordance with Lane's technique and soldered the wire in place as I described in a paper read at Rockford, Illinois, some time ago. We have used silver and copper wire and soldered it, first tinning it and soldering it as the tinner would ordinarily solder wire. In that way we prevent breaking of the wire in twisting and have no unwieldy ends to deal with nor bend down afterward. We have employed this method in fractures around the elbow-joint; we have applied it to fractures of the clavicle and to Colles' fracture of the lower end of the radius. It seems to me, it is an ideal way to use either copper or silver wire in fractures of bones.

I agree with Dr. Smith regarding infection. We have had very few cases of infection where the Lane technique has been followed out to the letter.

Dr. N. M. Percy: Dr. Neff expressed my sentiments when he said that this was one of the best papers on fractures he had heard for a long time. I agree with practically everything Dr. Smith has said. It has not been my practice, however, to remove a Lane plate except when it makes trouble, or when there is a likelihood of its doing so. I cannot see any objection, however, to removing plates, provided this is done early, as Dr. Smith advises, so as not to prolong the period of disability. On the other hand, it has been my experience that plates, properly placed, seldom ever cause any trouble. The successful use of plates is purely a matter of technique. I have put plates on every long bone in the body, the interval since operation varying from a few weeks to 12 years. During the past 12 years I have plated 260 fractures and have removed the plates in 8 per cent of the cases. An acute infection has followed the operation in only one case. In some cases the plates were removed because of a mild infection resulting in a sinus formation a few weeks to 3 months after the operation. In other cases the plates were removed because they had been placed subcutaneously. It is our practice to remove all plates placed subcutaneously, especially if this region is subject to traumatism, as is the lower portion of the tibia. A plate placed deep under the muscles is seldom removed.

In observing Dr. Smith's slides, I noticed that in three cases in which there was a fracture of both bones of the forearm, he plated one bone and wired the other. It was noted in all three cases that both the immediate and ultimate results were more perfect in the bone on which the plate was used than in the bone which was wired. I would like to ask Dr. Smith why when he found it necessary to make a fixation of both bones, he plated one and wired the other.

Dr. Harry Jackson: I would like to ask Dr. Smith whether he has inserted any plates in compound fractures. I have had a few of these cases and I have not been able to hold the fragments by any other means than by Lane plates. In using the Lane plate in the deeper tissues I have been surprised not to get any infection.

Dr. Budd Van Sweringen, Fort Wayne, Indiana: It was my good fortune to see some fracture work in San Francisco a few years ago, and it was the practice there to remove the plates in all cases before the patients left the hospital.

In some of my own work I have found good reasons for removing plates. In the first place the screws become loose in a short time and the fragments are not held securely always. No matter how tightly they were put in at first a pressure atrophy occurs around them and we find them loose in a few weeks. If the plates are left in very long, as shown in the plates this evening, there is a piling up of callus, so that you have to chisel down in order to get at the screws and remove the plate. This excess callus often causes pain and if near a joint some stiffness. These plates can be taken out easily if it is done early and whether there has been clinical evidence of infection or not, there will be found some more or less fluid material about them with a staining of the tissues. I am inclined to think that in some cases we remove the plates too early. There is no doubt but that a plate delays union. Its presence operates in some way to delay the formation of firm callus.

Dr. Coleman G. Buford: There is one important phase of this subject which possibly we ought to pay more attention to, namely, the medicolegal aspect. The lawyers, who are trying these Lane plate cases, seem to have been impressed by the testimony of a few men to the effect that it is wrong to leave Lane plates.

I, personally, do not think there is any law that can be laid down as to whether this should or should not be done at a certain time after the operation, and I am sure there is no uniformity of belief about it, and each surgeon giving advice or testimony should be very careful to state the case in some such form to the counsel.

Dr. P. H. Kreuscher: I was glad to see Dr. Smith using the Lane plate in so many of his cases with such good results. A prominent surgeon recently made the statement that the Lane plate method had practically gone out of use. I have used the Lane plate in many cases with satisfactory results and shall continue to use i where I believe it is indicated. I was glad to have Dr. Smith show the picture of the case in which he had used the Parham-

Martin band. I have used it in 10 cases in the last 2 years and find it applicable in spiral fractures of the tibia, femur, and humerus. I believe it should be used in short oblique and spiral fractures as well as in long oblique fractures.

I do not remove the Lane plate unless there is definite indication. I have never used a plate on compound fractures in the presence of infection. I do not believe that the Lane plate gets loose if the proper screws are used in its application.

In the last 2 years, I have used wire staples in five cases of fractures near the joint. I used staples in one case last week where there was a fracture of the external condyle of the humerus; also used staples in another fracture of the shoulder-joint. In one case two staples were used, one at right-angles to the other. This held in splendid position the head of the humerus which had been entirely disconnected from the shaft, had slipped out through the joint capsule and lay underneath the pectoralis minor muscles.

Dr. Smith (closing): I am very much obliged to the gentlemen who have brought out so many interesting points in the discussion of my paper.

In reply to the question of Dr. Hessert as to why we removed the Lane plates, I think an examination of the slides shown will answer that question, at least in part. You doubtless observed that in those cases in which the plate was removed early there was very little deformity in the bone, and very little irregular callus. You also remember in those two cases in which the plate was not removed there was a good deal of irregular callus. I think we get much nicer and smoother healing, less rough callus, when the plate is out. The point raised by Dr. Buford is also worthy of consideration. There is another reason why the plate should come out, and that is, a certain number of these cases will have trouble with the plates. If the presence of the plate does not cause infection it may be painful. Patients occasionally complain of some discomfort if the plates are so located as to be subjected to trauma.

Another reason for opening up these wounds and removing the plates is that you will find the tissues where the plate has been in contact with bone somewhat discolored, and often there is a little necrosis, and for this reason it is a good plan to get rid of the foreign body and give the bone a chance to make a complete restoration to normal continuity.

Another thing that happened in one case was that a man had a plate that had been applied and left in; he fell and broke his leg again at about the same point, and the old plate made a great deal of trouble for us in reducing the second fracture. That may be an unimportant reason for removing it, but in this particular case it was rather important.

In reply to Dr. Friend's inquiry, I would say that in the 38 cases in which we employed the Lane plate, we have had no infection which caused any trouble. In one or two cases we have had a little seropurulent discharge, but not enough to cause any trouble. These wounds heal like perfectly clean wounds. Since the paper was written we have had one plating case, in which there was slight infection, but the 38 cases mentioned in this paper were not accompanied by any infection.

Regarding the cases of Colles' fractures, with malposition, Dr. Kahlke inquired about, one of them was lost sight of after reduction had been effected, and the other died a year or two afterward from influenza, but so far as we know the result of this operation for reduction of the malposition was quite satisfactory. The patient never complained of any disability.

Dr. Percy inquired why in double fractures we plated one bone and wired the other. I think chiefly for cosmetic purposes.

In reply to Dr. Jackson's question as to the use of Lane plates in compound fractures, at the present time we have three compound fractures of the leg in which we have used Lane plates, after a thorough cleaning out of the wound. If the plate is applied in a place which is accessible for removal, that is, near the surface, and screws are used barely long enough to go through the bone and not penetrate the marrow, it does not increase the danger of infection I believe it is a good deal better to put on a plate temporarily and secure a reasonable degree of immobilization than to allow the limb to dangle around without any fixation, especially in those cases where both bones of the arm or leg are broken. In our practice we have quite frequently employed a small Lane plate to secure reduction and maintain it until a plaster cast or some other fixation device is employed, even in open fractures, and we have not seen any worse results, so far as infection is concerned, in those plated than in those which were not plated.

In regard to the Parham-Martin band, as mentioned by Dr. Kreuscher, it is an ideal device for certain cases. I want to warn, however, against leaving the band in and having to remove it at a subsequent time. These bands may be difficult to remove. I remember one instance in which a Parham-Martin band was put on by some one else, and the patient came to us on account of pain and irritation, and we undertook to remove the band and found it was so completely buried in callus that its removal was an extremely difficult undertaking.

# CHICAGO SURGICAL SOCIETY

Regular Meeting, Held January 7, 1921, Dr. William Fuller, Presiding

Dr. Karl A. Meyer read a paper on "Gunshot Wounds of the Abdomen."

## PERTHES' DISEASE

Dr. D. B. Phemister: This case of Perthes' disease is of interest because it was operated on and the pathological changes in the head of the femur and hip-joint were determined, and because of the postoperative regeneration that followed curettage of the diseased focus in the femoral head.

C. P., male, age 10, entered Presbyterian Hospital March 1, 1920, with the following history: Onset 5 months ago with pain and limp in right hip, which did not confine him to bed. After 3 weeks he was put to bed with weight extension of the limb, which was continued for 3 months. For the last 6 weeks he has been free of pain and walking around, but considerable limp and limitation of motion persist. Examination showed slight limitation of flexion, but marked limitation of abduction and rotation in the right hip-joint; otherwise negative. Roentgenograms showed flattening and cavity formation of the center of ossification of the epiphysis of the head. The diagnosis of Perthes' disease was made, and the patient left the hospital without treatment.

He returned 4 months later with slight increase of the limp, but was still free from pain. Second roentgenograms showed marked increase in size of the area of destruction and further collapse of the center of ossification of the femoral head. Two small sequestra could be seen in area of destruction.

The hip-joint was opened and a mild synovitis with a straw-colored effusion and villus formation was found. A window was excised from the head of the femur extending into the center of ossification which had broken down in its lateral portion, giving rise to a cavity filled with granulations, necrotic débris and sequestra. The cavity was thoroughly curetted and the hip-joint closed.

Bacteriological examination and guinea-pig inoculations of the material removed were negative. Histological examination showed a mild chronic synovitis and quiescent inflammatory changes with small sequestra in the tissue removed from the broken down center of ossification in the head.

Following the operation there was rapid filling in by new bone of the cavity remaining after curettage of the disintegrated head, and 5 months after operation practically all traces of the cavity had disappeared. The pathological findings speak strongly for the infectious nature of the disease, and the postoperative regeneration suggests that operation may be the most desirable form of treatment.

Dr. Coleman G. Buford: It seems to me that we are liable to confuse this type of cases clinically, with another group of mild hip disturbances which are believed to be at least one of the phases of coxavara in which there is a gradual separation of the head of the femur from the epiphysis with more or less destruction of one or both, and more or less rotation of the head. The X-ray plates of patients with this disease are very similar to those presented in this case of Perthes' disease, except that there is no sequestrum. I have wondered many times if these were not merely different pathological phases of the same affliction. If they are not the same pathological entity, then they must not be confused, as the clinical symptoms are so similar, for it is certainly true that those referred to as coxavara do very well upon non-operative treatment, and I should hate to see one of them operated upon in view of the results that may be obtained by prolonged immobilization in casts. I am familiar with the outcome of a few of these who have had this treatment and in whom the motion and usefulness of the limbs was very good and fully as satisfactory as we could expect from drainage.

## A COMPARATIVE STUDY OF END-RESULTS OF CHOLECYSTOSTOMY AND CHOLECYSTECTOMY

Dr. Frank D. Moore read a paper entitled "A Comparative Study of the End-Results of Cholecystostomy and Cholecystectomy." (See page 41.)

## DISCUSSION

Dr. A. J. Ochsner: I can heartily subscribe to the statements made in Dr. Moore's conclusions, but there is a tendency at the present time to give the impression that, because there is considerable trouble with many patients after cholecystostomy, therefore we should perform cholecystectomy. For several years there has not been a week but what I have encountered several cases of cholecystectomy that have had as much or more trouble after this operation than they had before. In such cases the cause of the trouble is probably one or another of the causes that have been mentioned by the essayist. I believe that, instead of adopting cholecystectomy as the rule, we should adopt it only in cases in which we have a definite reason for doing it; namely, a diseased gall-bladder or cystic duct. Dr. Moore has mentioned a group of cases in which cholecystectomy is contra-indicated, in acute inflammatory conditions in which this operation would endanger the patient's life, and in which we can remove the gall-stones and give relief temporarily, and remove the gall-bladder later on in perfect safety. In that case a diseased gall-bladder is not an indication for a cholecystectomy.

I had a case today in which I removed the gall-bladder 2 years ago. There was present at that time a small amount of connective tissue which I considered harmless but that connective tissue has increased so as to obstruct the common duct entirely, and the woman has a fistula. I have no way of diverting this fistula into the intestine because the gall-bladder is absent. In a normal gall-bladder from which we have removed stones the cause of later trouble is malposition and kinking of the cystic duct because of a sacculated or pendulous gall-bladder, or the irritation that one causes by inserting a drainage tube into the gall-bladder at the time of operation.

I had my cases followed some years ago and found that nearly all cases of cholecystostomy in which I had tamponed the gall-bladder with gauze after the operation and removed the gauze on the sixth day, and did not put a drainage tube into the gall-bladder had no trouble afterward. But the cases in which a drainage tube was used, and there was a considerable number of them, had trouble afterward. The drainage tube had caused ulceration of the lining of the gall-bladder, and that in turn caused trouble afterward. The gall-bladder was damaged as the result of the technique used, but would not have been damaged if the other technique had been employed.

In the plan of overcoming the pendulous gall-bladder by attaching it to the transversalis fascia and peritoneum, we have found a method which will usually prevent further trouble. I believe if the gall-bladder is not diseased, it is well to leave it in.

Dr. Coleman G. Buford: To emphasize the importance of this subject, I cannot do any better than to quote the remarks of Dr. Ochsner in which he said that "Operators seem to take the position that because there is a tendency in many patients toward repetition of trouble similar to the original, they would not have had these troubles had the gall-bladder been removed." The taking out of gall-bladders to the extent that it has been done in the last few years, has probably been followed by more difficulties than when the gall-bladders have been left in. The pendulum has swung entirely too far in the wrong direction, and we as surgeons who have had a large experience in this field of work and who have had ample time to review our work and the work others have done in the last 15 to 20 years, ought to check up on this situation, and make the subject clear to those who have not had the same opportunities, and by so doing, we may possibly diminish the number of gall-bladders that are being removed. It must be understood that in many of these cases, the infection was not primarily in the gall-bladder, nor could this have been true in half of the instances in which the gall-bladder was removed. On the contrary, the infection has usually been a diffused process throughout the bile-ducts including the terminals, and removal of the gall-bladder does not assist this in any way, but really, it limits the opportunity for prolonged drainage which is just the thing that we seek, and though we may at times get considerable drainage from the remnants of the cystic duct, should there be a recurrence of the difficulty for which we would need again to drain the biliary tract, most of the operators would find it pretty difficult to locate a source through which they might establish such drainage.

In the nineties, Fenger was doing a great deal of gall-bladder surgery. About 1898 he had operated upon 24 cases of common duct stone, while Dr. Senn, who probably did a very much larger volume of work had had only one. It must be remembered that the number of cystic duct and gall-bladder cases were many times more numerous than the common duct cases. I state this to show the volume of material which Fenger had to draw conclusions from. Shortly after I went with him I asked if patients who had stones removed from the gall-bladder did not again develop such stones. He remarked that he did not know and further stated that he was not having any of these patients come back and that he had several years of gall-bladder surgery behind him from which to form an opinion. I spent nearly four years in that clinic as first assistant, and almost all of the gall-bladder surgery came under my immediate observation, and I do not remember in all of that time of his having removed but two gall-bladders, nor do I remember having patients continually coming back complaining of their original difficulty. What was the reason for this? It was clear to us at that time that this was not primarily a gall-bladder difficulty, but a diffused process in the liver and that the liver needed drainage. It was also clear, from common knowledge of pathology, that a few days' or 2 weeks' drainage was not adequate, and therefore these patients often remained in the hospital 6 weeks and more instead of being hurried home, and the drainage tube taken out in a period varying from 4 or 5 days to 2 weeks. I believe it is this early removal of the drainage tube and the resulting inadequacy of drainage as to time, which is accounting for so many recurrences in the practice of some of the men. It certainly has not occurred in my practice where I have made it a point to drain for a long time.

Dr. Evarts Graham has substantiated the early assumption that this was a diffused difficulty by that splendid paper which he presented before our society 2 or 3 years ago in which he showed microscopic specimens taken from livers of nine patients with gall-bladder infection.

It is my opinion that there should be a definite indication in each case for the removal of the gall-bladder; that there must be extensive and permanent damage to the gall-bladder wall itself or to the cystic duct, to justify the operation of cholecystectomy.

Dr O. E. Nadeau read a paper (by invitation) entitled "Bone Metastases in Cancer of the Breast."

Dr. Arthur Dean Bevan read a paper entitled "Simplicity of Surgical Technique."

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN GYNECOLOGY AND OBSTETRICS

By GEORGE GELLHORN, M.D., F.A.C.S., Saint Louis

THE fourth edition of the *Operative Gynecology* of Doederlein and Kroenig[1] has just been published. Ever since its first appearance in 1905, this book has been a landmark in gynecology and the many thousands of gynecologists the world over who are acquainted with the work will agree with the statement that it has but few peers in modern medical literature. The authors were exceptionally well equipped for their task—both in the prime of life, both original thinkers and tireless research workers, brilliant operators as well as inspiring teachers to whom students would flock from all corners of the earth. Kroenig's untimely death a year or so ago threatened the continuation of his monumental work, but fortunately for us, Doederlein, as he remarks in the foreword, felt it his duty to the memory of his friend and collaborator to attend to the present edition. That this was no mean undertaking may be seen from the many changes and additions which the achievements of the last 8 or 9 years had made necessary and which have still further increased the already imposing size of the book.

The arrangement of the subject matter, however has remained essentially the same as in the former editions. The general part is constructed on a broader basis than is customary in works of this nature. It is based on the view that the general principles of operative technique, the pre-operative steps and the prophylactic and therapeutic measures after the operation may have more to do with final success than technical details. The problems of disinfection, of the illumination of the operating room, the choice of narcosis, the prevention of postoperative complications, a. o. are dealt with in this section. This part contains also a discussion on the effect of the removal of uterus and ovaries upon the female organism and the influence of gynecological operations upon the nervous system. Anybody who is familiar with gynecological literature knows that in this entire field the authors have either been pathfinders or that they have subjected to careful and extensive investigation suggestions that have emanated from other quarters. This general part of the book is, therefore, not merely a compilation of literature but a most valuable exposé of the subject based upon thorough scientific and practical critique. It is but natural that the extensive personal experience of the authors leads to individualistic expression, yet, everywhere do they give full justice to differing opinions of other writers.

This sympathetic attitude is equally well preserved in the second and larger part in which those gynecological affections are discussed which under certain conditions require operative treatment. The indications, technique, and results of the various operations are exhaustively presented in almost 800 pages. The gynecological operations in the strict sense of the word naturally receive foremost consideration, but the major obstetrical operations and those of the borderland of the urinary tract are also included. Finally, the principles of abdominal surgery are represented in the description of the typical operations on the stomach, intestines, and gall-bladder so as to meet the practical needs of the gynecologist.

Hardly ever has study been made as alluring or the teaching of good operating been presented as clearly and attractively as in this book. There is no encyclopedic dullness, but the selection of the best in gynecological surgery, and this best is given to us in a beautifully simple and fluent language which bears no resemblance to the massiveness and involved sentences that mar so much of scientific German writing. Even a superficial knowledge of German will suffice to follow the text, and if a word should be wanting here and there, a glance at the magnificent illustrations, which must be the envy of every textbook writer, will clear up any doubt. Indeed, the reading of this book is an unadulterated pleasure, and it is no overstatement to say that the work is truly indispensable to the modern gynecologist and surgeon. It is, therefore, fortunate that the comparatively moderate price of this beautifully appointed book of more than 1000 pages makes its acquisition possible to wide circles, particularly among American readers.

IN Anspach's *Gynecology*[2] we greet a new and noteworthy addition to our list of American textbooks. In an introduction, John G. Clark to whom the work is dedicated, very aptly characterizes it as one in which the literary references are selected with great care and successfully combined with the observations gathered from the author's matured

[1] Operative Gynaekologie. By A. Doederlein and B. Kroenig. 5th ed. Leipzig: Georg Thieme. 1921.

[2] Gynecology. By Brooke M. Anspach, M.D. Philadelphia and London: J. B. Lippincott Co. 1921.

experience. Thus a well-balanced textbook has been constructed that will admirably well answer the needs of the student and practitioner. The general plan of the book follows approved lines. The first four chapters contain the fundamental facts of embryology, anatomy, and physiology of the female genitalia which are essential to a full understanding of all gynecological problems. Then follows a short but very good chapter on the causes of pelvic disorders. The technique of arriving at a diagnosis by means of a careful anemnesis and the various methods of general and special examination is given in five chapters. The examination of the urinary tract and the lower rectum receive special attention commensurate with the importance of these organs to the gynecologist. The next seventeen chapters deal with the diseases of the various organs in which we are interested; in each of these the etiology, pathology, symptoms, and treatment are systematically and succinctly discussed. Separate chapters are devoted to such subjects as gonorrhœa, tuberculosis, syphilis, etc. The chapter on backache proves that the author never loses sight of the relation of the genital organs to the entire organism. A very attractive chapter is that on the hygiene of adolescence and the relation of neuroses to pelvic disorders. Operative technique and postoperative treatment are presented without undue detail, yet, in a concise and instructive manner. The chapter on mechanical and medicinal aids to treatment deserves particular notice in these times when gynecological treatises all too often overemphasize the surgical aspect of our specialty. The chapter on radiotherapy, finally, presents to the reader a clear résumé of the present status of this question.

The general appearance of the book is most pleasing. The numerous illustrations are well chosen and instructive. A very commendable feature is a bibliography at the end of each chapter. These references are apt to stimulate the desire for consulting the original sources and well illustrate the care with which the author has prepared his work. It is quite certain that this book will gain many warm friends among teachers as well as students.

ON reading the *Operative Gynecology* by Crossen[1] which has recently appeared in a second edition, it is easy to see why this book has achieved the popularity which we predicted in our review of the first edition.[2] Simplicity of diction and good drawings make every step of the various operations described plain to the reader and teach impressive lessons in successful operating. Where there is so much that is excellent, it is perhaps unnecessary to point out particulars; but the reviewer can not refrain from calling special attention to the chapter on radical abdominal hysterectomy for cancer. In this most difficult of all gynecological operations the successive steps are exceptionally well described and depicted, and the surgeon about to attempt this operation, will find himself well repaid by freely consulting the book. Another distinctive feature is a complete classification of all operations for retrodisplacement and prolapse, together with brief historical data. These operations group themselves into several categories and of each, one or more representative methods are given in greater detail and with the same lucidity, both graphic and pictorial, on which we have commented above. Aside from testifying to the great industry of the author, these two chapters are of signal importance in that they show the reader in how many different ways the problems of retrodisplacement and prolapse may be approached surgically. We continually talk and teach nowadays of individualization in therapy; but when it comes to actual practice, is it not a common observation that in the treatment of the two conditions mentioned many operators have one pet method, preferably one of their own invention, which is employed more or less in all cases? It is the old, old story of theory and practice re-enacted. Anybody with experience knows that the special pathology may be different in any two cases of the same disease, that in each one different problems may have to be considered; in short, that the patient to be operated upon is entitled to a selective treatment fitting her individual needs. In such a selection the book before us should be of immense value; but the beginner may well be bewildered by the multiplicity of methods that are presented to him. Some years ago there appeared in a Continental journal a review on the subject in which were listed 154 different methods, or modifications of methods, for the operative relief of retrodisplacement. This number has probably increased by now. Many of these procedures have definitely been discredited, others are still *sub judice*. It would simplify matters and materially aid the student to hear from a man of mature judgment something, at least in a general way, of the advantages or, better still, the proven disadvantages of the various methods; and the necessary space might well be obtained in the next edition by condensing the rather long chapter on ovarian transplantation.

THE fact that the second and enlarged edition of Green's book[3] has not been delayed by the war, indicates the value of the work and the well-merited esteem with which it was received. The author has chosen the form of case histories to illustrate pathological conditions characteristic of the five periods of woman's life, viz., infancy and childhood, puberty and adolescence, maturity, the climacteric and anility. Each of these sections is preceded by an introduction, and each case history is followed by an epicrisis in which the lessons to be learned

[1] Operative Gynecology. By Harry Sturgeon Crossen, M.D., F.A.C.S.

are emphasized. In this form of teaching there is no thought of substituting for textbooks—rather is it intended to give a very desirable supplement to bedside instruction and home study. Another strong point in the book is the attempt at closely linking together the sister sciences of obstetrics and gynecology. We have already commented upon this point in our review of the first edition.[1] The study of this book may be recommended not only to the student but also to the practitioner and the specialist, for each will profit from the wide experience of the author.

THE attention of gynecologists and obstetricians is hereby called to a small monograph[2] by Herbert Spencer, of London, in which the well-known author puts on record his experience, extending over a period of 32 years, with tumors complicating pregnancy, labor, and the puerperium. Thirty-seven cases of fibroids are reported in detail, Of these, 5 were treated by abdominal myomectomy; 5 others were subjected to conservative cæsarean section; and in 6, cæsarean section was followed by hysterectomy. Two women died from sepsis; 1 patient died, before operation, from intestinal obstruction due to nipping of the ileum between two subperitoneal fibroids. Fifty-five cases of ovarian cysts were operated upon in pregnancy, labor, or the puerperium; 44 others were not subjected to operation. Only 1 patient died. Ten cases of cancer have been observed. In 3 of these, high amputation of the cervix was performed after delivery and these patients have remained free from recurrence for 25, 22, and 19 years respectively. All other patients died. Space does not permit the recounting of details regarding diagnosis, interrelation of tumors and pregnancy, the fate of the children, etc. Suffice it to say that we have here an extremely valuable contribution on a most important subject.

BERKELEY and Bonney are among the most prolific writers in the field of gynecology and obstetrics, and their books reflect a wide personal experience. Here is the third edition of their *Difficulties and Emergencies of Obstetric Practice*.[3] The many good points of this book have been acknowledged in a previous review to which the reader is referred,[4] and which were summed up in the statement that the book is very pleasing and will be read with profit by obstetricians, young and old. It may be added here that the views expressed and the methods advised are, with but few exceptions, highly individualistic and as such they are of particular interest even though there may be a divergence of opinion here and there. There is, for instance, a peculiar position which the authors prefer for bimanual examination, where "the patient lies on her side with the cross axis of the pelvis oblique whilst the shoulders are nearly horizontal, the trunk being somewhat twisted at the waist." The authors believe that Abderhalden's test has no diagnostic value. The height of the fundus at 4 weeks of pregnancy is given as being 2 inches above the symphysis—a statement with which few will agree. In the treatment of the pre-eclamptic and eclamptic periods the authors favor prompt operative evacuation of the uterus, preferably by cæsarean section. Very little stress is laid on expectant therapy, and the Stroganoff method with its remarkably good results is not even mentioned. These actively surgical tendencies of the authors reveal themselves also in the problem of exophthalmic goiter in pregnancy where they recommend evacuation of the uterus prior to any operation on the thyroid. It will be remembered that the conservative school following Winters' lead, holds that by a timely thyroidectomy many a child may be saved. The treatment suggested for puerperal inversion differs in some essentials from the general usage; narcosis, for instance, which is commonly considered the best protection against shock, is not considered absolutely necessary; neither is the placenta, if still adherent, to be removed until the displacement is rectified, nor the exposed surface cleansed before reposition. Interesting observations were made on 200 patients delivered in "twilight sleep"; labor was prolonged, the use of the forceps was more often necessary, the percentage of ruptured perineum was higher, and the failure of occipitoposterior position to rotate normally was commoner. "When born in a condition of oligopnœa the child should be placed in its cot and left alone. There is no doubt that some practitioners, failing to recognize that the child is really not in danger, have applied vigorous methods of resuscitation with very bad results." As regards obstetrical disinfection, the authors regard "violet-green," a member of the aniline group, as ranking foremost among the non-irritating, yet powerful antiseptics.

This selection might be extended considerably but it will suffice to indicate that the specialist in obstetrics will read this book with a great deal of interest.

PARTICULAR attention is called to this *Report*[5] in which 22 papers by members of the staff are reprinted. This volume shows not only the valuable clinical research which the staff members have conducted in addition to their routine duties, it also reflects the appreciative attitude on the part of the Board of Directors composed of laymen who seem to be in closest co-operation with their medical staff and in cordial sympathy with their problems. Other Hospital Boards, please copy!

[1] Surg., Gynec. & Obst., 1916, xxii, 634.

[2] Important Complications Pregnancy, Labour, and the Puerperium. By Herbert R. Spencer, M.D., B.S., F.R.C.P. London: Harrison & Sons, Ltd.

[3] The Difficulties and Emergencies of Obstetric Practice. By Comyns Berkeley, M.A., M.D., M.C. (Cantab.), F.R.C.P. (Lond.), M.R.C.S. (Eng.), and Victor Bonney, M.S., M.D., B.Sc. (Lond.), F.R.C.S. (Eng.), M.R.C.P. (Lond.). Philadelphia: P. Blakiston's Son & Co., 1921.

[4] Surg., Gynec. & Obst., 1915, xxi, 547.

[5] Report of the Scientific Work of the Surgical Staff of the Woman's Hospital in the State of New York. Edited by George Gray Ward, Jr., M.D., F.A.C.S. Vol. II, 1919.

THIS Nursing Manual[1] contains a great deal more than its title and its purpose would indicate. In fact it is so complete that any medical student who knew all there is in it would pass through examination with flying colors. The mere fact that the book has appeared in nine editions since 1903 proves that it has been a trustworthy guide to the trained nurse. There is an exceptionally clear and simple exposition of the matter, and everywhere is the nursing aspect properly emphasized.

To teachers of obstetrics for nurses the book opens a new trend of thought at this time. We may have wondered sometimes whether we have not been overtraining our nurses; whether or not less information about the segmentation of the ovum and more regarding painless catheterization had been in order, less of fœtal circulation and more about resuscitation, less of internal or external rotation and more regarding the care of a patient in an eclamptic convulsion. And now that the "obstetric attendant," this glorified sort of an upstairs maid, has appeared on the scene, greater emphasis on the purely practical aspect of obstetrics will be still more desired. For this new category of helpers, books such as the present volume and others of like type seem almost too erudite, and "first readers" in obstetrics will have to be written in words of one syllable. Let us hope that the existing scarcity of nurses will soon be remedied so that the American nurse may maintain her high standard for which she is justly famous throughout the world.

IN the meantime there is all the more reason for redoubling our efforts to educate the prospective mother. There is an abundance of "guides for mothers" on the market, and their very number indicates that the public is eager to read and to learn. The little book before me[2] seems admirably well suited to satisfy every demand on the part of the laity. It gives the prospective mother just what she needs—not too much as unfortunately many of these "guides" do; and, furthermore, it uses plain, straight English. In the entire volume, there are but two technical terms—"hypersecretion" and "toxic"—which remain unexplained, and these might easily be replaced by simpler words in the next edition. There is sound and practical advice throughout the little work, and the sympathetic and encouraging tone in which it is written makes it very likable. Not the least valuable part of the book is an appendix with directions about household remedies and reparation of diets. In the prenatal and postnatal care of his patients the physician will find this booklet of great assistance.

[1] A Nurse's Handbook of Obstetrics. By Joseph Brown Cooke, M.D., Obstetrician and Gynecologist to Garfield Hospital, Washington, D.C., and Caroline E. Gray, R.N., and Philip L. Williams, M.D. Philadelphia and London: J. B. Lippincott Co., 1920.

[2] Maternitas, a Book Concerning the Care of the Prospective Mother and Her Child. By Charles E. Paddock, M.D. Chicago: Lloyd T. Head & Co., 1920.

# AMERICAN COLLEGE OF SURGEONS

## SOUTH AMERICAN SURGEONS

Report of Official Visit to Peru, Chile, Argentine, and Uruguay in Behalf of the American College of Surgeons, by Franklin H. Martin, M.D., Chicago

### Foreword

AGAIN we are upon the comfortable ship *Ebro,* drifting down the Hudson River, passing the great skyscrapers and the Statue of Liberty. As we wave farewell to the Palisades, with their snow-capped columns, we realize that we are leaving the January winter of the United States and are started on our voyage to the southern continent and a summer climate. While the Statue of Liberty is still bestowing her silent blessing upon us, the liberty-loving Americans are gathering in the comfortable smoking room and drinking toasts to the snow-bound inhabitants of dry America.

This is the beginning of a tour of two surgeons and their wives to the countries of South America, primarily for the purpose of creating a closer friendship between the members of their profession on the two continents, and, secondarily, to become familiar with their forms of government and with their institutions of learning, to enjoy the novel scenes among which they live, to participate in their home life, and, above all, to learn the secret of their charming courtesy.

This is the writer's second trip to South America. It is a natural sequence to repeat the trip to that continent because of the inexhaustible things of interest with which a surgeon comes into contact on a first visit. The medical men of South America have not awaited our coming, but have perfected themselves in the art and science of medicine and surgery until they have no peers; and now, with dignity and seriousness, they are ready to interchange visits with us and to receive us with all of the cordiality and graciousness of their cultivated natures.

The visit of Dr. W. J. Mayo and the writer, which was made last year, included Peru, Chile, Argentine, and Uruguay. It was undertaken for the purpose of interesting the surgeons of these countries in the American College of Surgeons, and extending to them Fellowship in the College. Our mission was most pleasant and most successful and our advances were received with enthusiasm. Seventeen surgeons of Peru, thirty of Chile, sixty-three of Argentine, and fifteen of Uruguay were presented as candidates for Fellowship in the College by committees of surgeons that were established in each of the countries. It was with the greatest regret that we were unable, on this first visit, to make personal acquaintance with the profession of Brazil, Ecuador, Colombia, Venezuela, Bolivia, and Paraguay; but the lack of time and limited transportation facilities made it impossible.

Now, with Dr. Thomas J. Watkins of Chicago as a companion, we are visiting Peru, Chile, Argentine, and Uruguay again, and Brazil for the first time, while, through the good offices of Dr. F. J. Corrigan of Cleveland who preceded us, committees have been established in Ecuador and Bolivia, which countries will be visited later by the officials of the College. We also hope to include Venezuela, Colombia, and Paraguay.

### I. The Voyage

The voyage to South America, if undertaken in January or February, brings the traveler to Chile and Argentine during their summer vacation months. However, there is compensation in the fact that it enables one to escape the severest months of our winter; it affords a long, delightful, comfortable sea voyage in tropical waters; and it enables one to enjoy in those southern countries a climate similar to that of Southern California in the same months.

We sailed from New York on January 29. After two days of cool weather, but a comparatively smooth sea, we enjoyed the sunshine and warmth of the Florida coast, with St. Augustine, Ormond, Daytona, Palm Beach, and Miami easily discernible. On the fifth day we anchored in Havana Bay, lunched in Havana, and had a hasty bird's-eye view of this old and interesting city.

## II. Isthmus of Panama

### 1. *The Canal*

On the morning of February sixth our ship steamed into the harbor of Colon and we landed on the Isthmus of Panama. Small clouds on the horizon obscured the sun and the flat lands of Colon were not yet in sight. At eight o'clock the low lines of the coast appeared and the shipping of Colon came into view. War ships and commercial ships from all over the world were everywhere about. We took on the pilot, the quarantine officers, and the customs men, and slowly slid alongside one of the large, substantial, clean docks.

As we approached this gate to the great water-cut we enjoyed the same beautiful scenes we had looked upon previously—the coast-line of billowy, feathery green of the jungle, with here and there a two-story, red-roofed, screened-in government employee's residence, a hospital or an office building, and royal palms occasionally projecting above all like great feather dusters.

In Colon we observed "the system," which is exemplified in the well-built docks, and the loading and unloading, icing, and cooling facilities furnished alike to the ship traffic of the entire world. Shortly we took a special train for our ride across the Isthmus. Our first stop was at Gatun Locks, just to the east of Gatun Lake, which is twenty-eight feet above the Atlantic Ocean. From this vantage point we looked about and saw the great spillway that carries off the surplus water, and that also creates the electric current that furnishes light and power for the gigantic machinery of the Panama Canal; the attractive towers from which the operators control by electric buttons the seemingly intricate mechanism; the traction engine and the engineer who guides the various ships through the great Locks that will accommodate any vessel, regardless of size; the emergency gates standing idle waiting for the unforeseen. However, the real charm is in the warm and balmy atmosphere, in the soft blue mist, in the little mountains which extend north and south and connect the mountain ranges of the two Americas, in the velvety sward that we walk upon, fashioned by nature from fern-like grasses and the little vine with the miniature purple daisy, in the watch-like perfection of it all, in the little villages with their red-roofed houses the white fronts of which are covered with red and purple bougainvillea, all guarded by royal palms and buried in ever-growing tropical green. While many of the miniature mountains were cleared of growth in the construction of the Canal, a carpet of smooth green remains and extends to the water's edge.

We skirted the great lake created by the overflow and were fascinated by the dead trees on whose tops rested orchids and other parasitic growth. We disembarked from our train and went through Culebra Cut on the little submarine chaser, the *Gold Star*. The quicksand-like bottom of the Cut is being elevated continuously by the pressure from the mountain-hills on either side, and there is nothing to do but scoop out the earth with their great dredges, either until there is no bottom or until the two mountains have been hauled away. After passing through the Cut, we again boarded our train and passed through the slip to the Pacific. Everywhere are the purple mist, cleanliness, and signs of the careful husbandman. It is here that Gorgas did his magnificent work in building an everlasting monument to the people of the tropics. As it was once the pestilence spot, it is now the health garden of the tropics.

### 2. *Panama*

We passed through Balboa with its new administrative buildings of Spanish architecture, and the Ancon Hospital resting on the terraced hill, and arrived at the Panama station, whence we were hustled to our hotel, the Tivoli. All we had seen on the Isthmus was beautiful when last we viewed it, but on this second occasion there was no disappointment; it was more beautiful than ever. Surely Panama must become one of the great resorts of the world.

After luncheon we drove through Balboa, out to Fort Amazon, and over the causeway which has been built from the earth taken from Culebra Cut to the nearby islands that are so wonderfully fortified for our protection. Looking back, we saw low-lying Panama with its attractive towers and its substantial Spanish architecture. On our return we drove through the streets of Panama. As this was the week preceding Lent the carnival, which is celebrated in all Latin-American countries at this time of the year, was in full sway. Beautiful children, and young men and women with skin of all shades, brilliantly dressed but in good taste, were here holding forth in innocent gaiety.

We saw our numerous friends, and on the following day inspected the new site for the St. Thomas' Hospital, visited other points of interest, and later had luncheon with our professional friends on the broad balcony of the Union Club, which overlooks the Pacific.

*3. President Belisario Porras—Gorgas Memorial*

By appointment, we called on Señor Belisario Porras, President of the Republic of Panama. The purpose of my interview with the President was to discuss with him the proposed memorial to General William C. Gorgas, a memorial that will be an object lesson to the people of the future; that will typify that great man's character; and that will carry on the work that his genius has organized and that his industry has so successfully administered.

Señor Porras is sympathetic to and is taking the initiative in a plan that would establish in Panama such a monument — a great laboratory in which could be conducted a research in tropical diseases; a working place that would attract the distinguished research workers of the world; a school that would disseminate to the practitioners of medicine from all countries the knowledge that would be required by its workers.

In this country the plans are being developed by Rear Admiral William C. Braisted, M.C., U.S.N. (Retired), and Señor Don J. E. Lefèvre, Chargé d'Affaires, Panama Legation, Washington.

At four o'clock our staunch ship quietly slipped out of Balboa Harbor. It was early enough to enable us to watch the new city of magic beauty, Balboa, and the romantic old city lying farther to the south, Panama, slowly disappearing on the horizon as we steered among the fortified islands of the Canal's entrance toward the southern continent.

## III. Peru

*1. Lima*

With five days of perfect sea and a delightful temperature, we sailed straight past Colombia to the head-lines of Ecuador, where in our imagination we saw Guayaquil which until two years ago was one of the last strongholds of yellow fever, and where our Gorgas accomplished his final successful work. We crossed the Equator and continued south to the romantic land of Pizarro—Peru, where at Callao, the seaport town of its famous capital, Lima, we disembarked for two days of pleasure and profit. During our stay in Lima we were the guests of our friend, Dr. Juvenal Denegri, at his home in beautiful La Punta, a summer suburb of Callao and Lima.

A luncheon was given for us at La Punta on the afternoon of the first day of our visit in Lima. The same evening we were the guests of the Sociedad de Cirugia del Peru at a banquet held in the Botanical Gardens of Lima.

We were kept very busy exploring this romantic city, which was the center for the Spanish adventurers who conquered Peru and destroyed an ancient civilization. We visited the Cathedral where lies the conqueror and the conquered, Pizarro, and the museums in which are preserved the relics of the Incas; we viewed the mountain sentinels that surround this old city, the narrow streets, and splendid monuments; we took a sea drive along the rugged coast, and listened to the cheer of children; we admired the stolidity of the Indian police, absorbed the atmosphere, and enjoyed the charming friendship of the interesting people. In two days we endeavored to accomplish the impossible—gain an impression of Peru's historical and physical charm.

*2. President Augusto B. Leguia*

Through the courtesy of our Ambassador at Lima, I was afforded the pleasure of an interview with Señor Leguia, President of Peru. Señor Leguia, who knew General Gorgas personally, was most enthusiastic about the proposed plan to erect a memorial to General Gorgas at Panama, and volunteered his active support.

*3. Mollendo*

In the evening of Sunday, February sixth, we sailed south on a smooth sea. The temperature was delightful, about seventy to eighty degrees Fahrenheit, with pure, dry, stimulating atmosphere in a territory where no rain has fallen for many years. We were fanned daily by the cool breeeze of the Humboldt Current, which kept us comfortable and keen to enjoy our long deck hikes. The rugged coast of the continent and the coast range of mountains were constantly in view, and we had occasional peeps at the snow-capped Andes beyond. Our next stop was at Mollendo, a Peruvian outlet from Bolivia.

## IV. Chile

*1. Arica—Tacna—Iquique—Antofagasta—Valparaiso*

The following day we stopped at Arica and enjoyed a trip across the desert to Tacna. We also had one day each at Iquique and at Antofagasta, the export depots for copper and potash. At Antofagasta we met friends who were anxious to hear from us northerners the story of the day.

Sunday, February thirteenth. Early in the morning we sailed into the Naples-like Bay of Valparaiso and saw in the distance a smoky haze over the city. As the sun cleared the mist and revealed the city in the curved indentation of the sea, it became apparent to us that something unusual was happening. We heard the booms of guns and shortly discerned the faint

bray of bugles and the fainter tones of smaller instruments. We wondered if this was a welcome to the voyagers of the obscure SS. *Ebro* on which we were approaching. If so, it was a royal welcome, because with a nearer view we noticed that the terraces of the city were crowded with the people who cheered and waved flags. However, we were soon disillusioned and made to realize that our ship was not the object of all of this attention, for in the opening to the harbor stood a great black hulk which proved to be the Chilean monster war vessel, *El Torre*, that had just arrived from the shipyards of England. Close to it, flylike, were a multitude of smaller steamers, and around them smaller launches and row boats. The new battle-ship stood out majestically, its rigging and decks covered with men and officers at attention for the welcome of a proud nation.

Valparaiso, the seaport metropolis, and Santiago, the capita lof Chile, were before us to be explored during the coming few days. A delegation of old friends boarded our ship early in the morning and told us of the program for our one day's stay in Valparaiso and then left us for a little time. At one o'clock they returned and with them in full regalia for the festive occasion of greeting the new battle-ship, was Dr. Alberto Adriasola, the Surgeon-General of the Chilean Navy. It was good to look upon his handsome face again. There appeared also the inevitable newspaper men with their batteries of cameras.

We were tucked away on the Admiral's launch and wended our way to the battleship, *El Torre*, where under the chaperonage of the Surgeon-General and under the conduct of the Commander of the ship, we inspected it from its keel to the conning tower. It was an inspiring sight to look down from the dizzy heights of the ship upon the hundreds of smaller craft that were there to give welcome, and off to the shore-line of the curved bay where appeared the terraced heights. The day had become more beautiful with sunshine and great fleecy clouds, and a temperature like our fresh June days of the north.

### 2. *Viña del Mar—President Arturo Alessandro*

When we had fully enjoyed the great ship we were taken ashore, and in automobiles drove through the suburbs of Valparaiso, passing along the stately avenues which were lined with handsome villas, the summer residences of the society of Chile, and on to the most wonderful of race-courses at Viña del Mar. It was a gala day at the races as a Prince of Spain was occupying the President's box, close to which were our seats. The races were beginning, and disregarding tips we placed our bets, and with the luck of the inexperienced, won.

In the promenade we met Dr. Amunategui of Santiago and other friends of last year. While walking with one of the charming señoras the band began to play and everyone stood at attention. It was the national air; the President had arrived. Naturally we were desirous of seeing him, and the Señora said: "You shall meet him." She took us to him and introduced the members of our party, as he stood unostentatiously under a large tree. He seemed more pleased than bored, and attempted a few words in English. He, Arturo Alessandro, has been in office but a couple of months, and he is astonishing the old conservatives by his democratic ways. He insists upon going about, apparently unattended, although the Señora said he was constantly under the surveillance of secret service men. From appearances, he might on this day have been any one of a thousand well-dressed, unofficial holiday citizens instead of the Chief Executive of a great nation.

We received an invitation to attend the ball which was being given that evening in honor of the Prince. This was very tempting as all of the society of Chile would be present; but we were obliged to reluctantly decline.

Back to the race-course we wandered and watched with interest the great crowds of people as they surged about the track and the grandstand during the race, and when the race was finished, as they rushed to the promenade where champagne corks popped in the restaurants and gaiety was everywhere manifested by these Latin people.

### 3. *Surgeon-General Alberto Adriasola*

Our hosts then drove us back toward the city, and after driving about its edge we entered upon a valley road, from where we climbed to the heights above the town and finally emerged at the entrance to an attractive villa which was situated on a terrace above the drive. We walked up the steep winding path, on either side of which were flowers, shrubs and tropical trees, to General Adriasola's home. Here we met his charming family—his wife, daughters, sons, and son-in-law. Our greeting was such as we had learned to expect from these people of the south—so warm, so gracious, so friendly. This charming family captivated us, and I have never known a father and a mother who seemed to have more to make them satisfied.

The view from the balcony of this home was most inspiring. Far below us lay a panorama of

Colonel Henry Clay Fisher, M.C., U.S.A., Chief Health Officer, Canal Zone, Panama.

Dr. Francisco Graña, Professor of Surgery, Faculty of Medicine, University of San Marcos, Lima, Peru.

Valparaiso Bay with its mass of shipping. The entire fleets of the nations could anchor here within plain view. Indeed, only a week previous to our arrival our own Pacific Fleet was anchored in the Bay, and the charming señoritas pointed out to us where this or that favorite Yankee battleship had lain. They had sailed away within a fortnight, and who knows how many fair Chilean hearts were hidden in secret recesses of those ships?

After tea we took a last look from the upper balcony. The sun had fallen into the Pacific; a brilliant glow covered the sky and gradually faded; and as darkness came on a planet appeared, then a thousand twinkling lights, outlining the city below like sparkling jewels.

### *4. Banquet at Union Club*

Awed and silent we drove down to the city with our friends. To make our welcome even more impressive, a waning moon came into view over the eastern mountains, and in its familiar appearance and charm we were brought back to earth. At dinner at the Union Club we met the surgeons of Valparaiso and their wives, a charming company in whose society we passed a most interesting evening.

At midnight, and as a climax to this great day, our friends took us in their launch to our ship which was anchored a half mile out. The Bay was flooded by the moonlight, and above us shone the Southern Cross, reminding us that we were far from home. But around us was abundant evidence of new found friends who would endure for all time.

### *5. Valparaiso to Santiago*

Early the following morning we bade adieu to our good ship *Ebro* and were taken ashore, where we boarded a train for Santiago, the first arm of our trip over the Andes. The green of the fields and the colors of the flowers were heightened by a heavy dew. Our gradual climb through the valleys of the foot-hills of the mountains of this narrow country was an ever interesting panorama of hamlets, fields of corn, alfalfa, wheat

Dr. Guillermo Gastañeta, Professor of Clinical Surgery, University of San Marcos, Lima, Peru.

Dr. Miguel C. Aljovin, Professor of Gynecology and Clinical Gynecology, University of San Marcos, Lima, Peru.

and oats, and extensive pastures on which well fed cattle and horses were grazing. On the terraces of the hills and on the slopes were many varieties of fruits—mangoes, melons, nectarines, peaches, oranges, lemons, pineapples, pears, alligator pears, plums, apricots, and luscious grapes. We followed the beds of rivers and smaller streams which in March are not over-full. Our train skirted hillsides and gave us an everchanging view of the valleys and glimpses of the second range of hills, with the real mountains beyond and an occasional view of snow-capped premiers still farther east. At the hamlets the natives, many of them half-breeds, were displaying their wares—fruits, bread, and cakes of all descriptions. Along the road-side were adobe or bamboo huts often thatched with palm leaves, and in the open spaces about the huts congregated innumerable children and dogs.

### 6. *Santiago*

By many meanderings we passed over one range of hills and finally dropped into the valley that holds, like a gem on a Princess' bosom, the capital city of Chile—Santiago. We recognized it by the island-like mountain, Santa Lucia, a sentinel in brilliant uniform which, with distinction and dignity, stands guard in the center of the city.

While in March one can view at leisure natural and artificial beauties of this Capital, the society and important professional and business inhabitants are away in the mountains or at the seaside. We viewed the beauties of nature and explored the curious things of this Latin city, drank in the pure, dry air of its valleys, and were inspired by its mountain sentinels that have guarded the valley through the ages.

## V. The Andes

### 1. *Santiago to Los Andes*

On the third day we boarded our train which followed a mountain stream and climbed into the foot-hills which constantly became more and more rugged, until we finally faced the backbone of the Southern continent, the Andes! The trip from the coast at Valparaiso to the coast

at Buenos Aires is made in three stretches, the first from the coast or Santiago to Los Andes, Chile, a small city well up in the foot-hills of the western edge of the real Andean mountains; the second a fourteen-hour daylight trip from Los Andes over the Andes by a narrow-gauge cog railroad to Mendoza on the Argentine side; and the third a twenty-two hour trip from Mendoza to Buenos Aires on a broad-gauge train with sleeping and dining cars attached.

At five o'clock we reached Los Andes, which is an attractive city with much green foliage, water running through the streets, and clean pavements of cobble-stones. A plaza or park, with a promenade and a band-stand, occupies a central location, and here all the citizens congregate, some of them well dressed and refined in appearance, others the peasants, many of them half-breeds in picturesque, highly colored costumes.

The hotel, which has clean, cubby-hole rooms, is built about a concrete-floored patio in which an elaborate dinner was served out of doors under electric light. This was indeed a welcome ending to an interesting day.

### 2. *Los Andes to Mendoza*

As the time would be too short for this daylight trip over the Andes if one started late in the morning, it is begun from either Mendoza on the Argentine side or from Los Andes on the Chilean side at six o'clock in the morning. The narrow-gauge train of three passenger coaches and a well-stocked commissary car awaited us in the court-yard of our hotel. It was a cheerful if a sleepy group that climbed aboard, all full of anticipation for the great scenic experience of their lives. The little train, business-like, began its upward journey. A raging stream from the mountains dashed impatiently about the great boulders, the ambitious waters throwing spray which in the sunlight made innumerable rainbows. At this level a wealth of low-hanging willow trees bordered the banks of the river, and in the fields and on the mountain sides were trees bearing bananas, oranges, and many strange, unknown fruits. Almost immediately we were in the midst of rugged, rocky peaks, the bases of which were green but the tops bare and sharp. The train plunged through tunnels, traversed shelves of rock, crossed valleys, only to find another shelf or another valley beyond; but constantly reached higher levels. Shortly many snow-capped peaks came into view, and in many recesses of the mountains where the sun rarely penetrated were piles of snow and miniature glaciers.

Dr. Alberto Adriasola, Chief Surgeon, Naval Hospital, Valparaiso, Chile.

Only a foolish and ambitious writer would attempt to describe a mountain scene; and it is an ambitious traveler who after one or two trips can remember the varied details of a ride over the Andes; and photographs are but a meager reminder and an aggravation.

After struggling through a labyrinth of smaller but impressive mountains, traversing smaller valleys, and following many rushing rivers (any one of which if properly harnessed would furnish power to operate the whole Andean system of railroads), the little train emerged in a wide, placid valley in which is located a little hamlet through which a flat river winds its way. The whole valley might be located in New England, its surface is so undramatic. On a pile of lumber sat an American woman caring for her child, an attractive little tow-head who was playing with improvised toys. The husband and father was undoubtedly an American engineer who busied himself in an attempt to find a way of transforming the unlimited power of the Andes into American dollars.

But the beautiful valley lying in the sunshine is but a resting place for nature before she shows the sightseer what she really can do to astonish him. Some one called attention to the giant mountains ahead, to the great fields of snow that spread down to our very feet, to one opening and still another a half mile above us. Between these openings which penetrated the heights we could see the little shelf dug out on the mountain side, and were reminded that that was where we were going. Still farther above us, near the clouds, was another shelf constituting one more great switchback to guide our frail train to still higher levels. Within a half hour we were looking down from the first shelf to the placid valley where the little child was still playing, and within an hour we were gazing back from the upper shelf, from where we could see the trail, a zig-zag little ribbon of bareness worn out of the eternal rocks representing the trail of the traveler in the older day before the railroad was constructed. All about us were the giant mountains, and while we were nearly two miles above the sea level, they still towered above us in their majesty. At this height we emerged into another valley in which, between the peaks, as if in the palm of the Creator, was the beautiful Inca Lake, five miles long and three miles wide, surrounded by masses of broken rock that some volcanic convulsion had tossed into the breach. We climbed from our train to get a nearer view of this distinguished body of water with the blueness of the Monday rinse, and drank in its beauty and its solitude. Climbing still higher, we finally reached a little barracks and the customs house that marks the border of Chile. Here we entered the tunnel that connects Chile with Argentine.

## VI. Argentine

### 1. *The Christus Aconcagua*

This tunnel through which we were passing is one of the great engineering wonders of the world. It is two miles in length, and has the distinction of being at as great a height as it is long. In its construction the estimate and actual chainage were practically identical, while the floor levels from the two sides met almost exactly. On the Argentine side were the customs house officials of that country, and as we alighted some one pointed to a depression between two heights under which we had tunnelled where stands the Christus, a gigantic statue erected by Chile and Argentine as a symbol of perpetual peace.

As we began the descent on the Argentine side, we saw beside the road-bed a little stream two feet wide, the head waters of the Mendoza River which at its mouth is a mile in width.

Soon after crossing the summit the train creaked to a stop. "All out to see the premier peak of the North and South American continents." We were now among the elect. All around us was a group of great ones. As is true in looking upon a group of distinguished men, it was difficult in such an assembly to pick the most distinguished. Mount Aconcagua, a long, low, range-like monster covered with snow, forty miles away, does not stand up in so satisfying a way as does Shasta, which although only one-half its height has the advantage of being a great mountain among small ones. Aconcagua is a giant among giants.

### 2. *Puenta del Inca*

A few miles farther on we disembarked at Puenta del Inca, an Argentine mountain resort frequented by the society of Mendoza and Buenos Aires. An attractive hotel occupies a space above the little valley, and all about it tower the mighty peaks of the Andes. Close to the hotel is an interesting natural bridge which spans a boiling river, and there are hot and mineral springs which are utilized as medicinal baths. The walk from the station to the hotel in the altitude leaves one breathless, but if of a strong heart, keen for the good things of the table which are served at the hotel.

Having satisfied the inner man we began our descent and followed the little stream that was growing lustily into a rushing torrent. We remembered that last year, at one point, the end of a passenger coach was protruding from its turmoil, demonstrating the insecurity of our shelf on the mountain side, especially as above us in an almost perpendicular line were granite walls, ready to send down an avalanche of rock which would carry with it the trivial work of man. In contemplating the wonders of this trip, one has great difficulty in deciding whether to admire more the work of nature or the work of man. In many places and at many times one may see duplicates of this great scene; but I doubt if there is a place on earth where for fifteen consecutive hours one may traverse a mountain range and see the constant development of marvellous scenes like those of the Andes, with the premier peak of a continent almost constantly in view as a basis for comparison.

In the afternoon sun the bare cliffs on the eastern descent present not only the usual grandeur but a symphony of startling color—deep reds, deep and pale greens, deep and pale purples,

and yellows in a riot of shades, while above is the blue sky with great fleecy clouds caressing ambitious peaks. As the twilight falls, with the sun apparently setting many times as we curve about among the mountains, we are awed into silent contemplation by the wonder of it all. Finally darkness descends and the stars and planets seem near enough to touch. One year ago, as we approached Mendoza, we looked up from one of the deep valleys through which we were passing and there in the distance, in the light of a full moon, not disappointingly as in the noonday, stood, boldly and in great majesty, Mount Aconcagua with a panoply of glistening snow and ice. It was a fitting climax for the last scene of a great drama. Night rolled down the curtain, and we sped into the city.

### 3. *Mendoza*

Tired and hungry, we transferred to a broad-gauge, solid train of the continental type which consisted of comfortable compartment sleepers and two well-stocked diners. The linen was clean, the waiters keen, and the food delicious and welcome to a group of tired people who, each in his own way, had "taken in" the Andes.

Mendoza, the wine center of Argentine, its fields for miles filled with growing vines loaded with purple fruit, is a well-lighted, modern city. Its altitude makes its climate attractive for the people of Argentine during the hot months of the year. Although unusual for this season, a terrific rain had fallen for twelve hours, and had, they told us, extended east over the normally dusty pampas. Water stood in the low places of the streets, rushed through the irrigating ditches, and everywhere was delicious freshness. This presupposed a peaceful sleep, with fresh air filtered of all dust.

### 4. *The Pampas*

When we awoke in the morning, our train was passing quietly over the flat plains. The roads were wet, and large fields covered with water stretched in every direction. While eating our breakfast we could see from the window myriads of wild fowl. At several places great flocks of flamingoes flew away and circled back to light again upon the water after the train had passed. These creatures, as large as swans and graceful in outline, with a wing spread of from three to four feet, are of the most beautiful scarlet, and as they leave the water and fly in flocks one can only liken them to great flames of fire.

The pampas are endless, and for hundreds of miles they are as flat as a billiard table. They produce everything that will grow in Nebraska, Kansas, or Iowa. The pampas grass, tall and graceful with its plume of white, is everywhere noticeable. There are miles and miles of grazing lands, with thousands of cattle, sheep and horses. Occasionally we saw flocks of ostriches which like colts in a Wisconsin field ran away in mock fright as the train appeared, displaying a wealth of fluffy feathers that would make a Fifth Avenue milliner turn green with envy.

There are not many towns, and few comfortable farm houses. The land is owned by non-residents, and the tenants evidently have neither the inclination nor the authority to demand the comforts that are enjoyed by the farmers of our own western and central states. At any rate, it so appears to the casual traveler. Country roads, which might attract the automobile tourist, have not yet been constructed in Argentine.

### 5. *Buenos Aires*

The approach to Buenos Aires is similar to that of all large cities — through a preliminary preparation of more and more pretentious suburbs. Buenos Aires, the metropolis of South America, impresses one as does any great cosmopolitan city of beauty in the world. Its people are well dressed, courteous, and have the appearance of prosperity; its streets are well paved and clean; its vehicles of transportation (automobiles, electric cars, wagons, etc.) are similar to those of Paris, New York, or London; its hotels are continental; its public buildings imposing and attractive; its parks numerous, well kept and accessible to everybody; its monuments are artistic and full of meaning; its opera houses and theaters not unlike those in the continental cities where art prevails; and the commercial spirit is in abeyance. The newspaper men, while persistent, are considerate and enterprising; the cab drivers are alert but possess the same speed mania that seems to have taken possession of the world; the streets are adequately policed, and the traffic regulations are enforced. The city administration must be efficient.

We were met by friends and driven to the Plaza Hotel, which was not new to us as we had spent a pleasant week there last year. It was rather like going home, and the friends and flowers that welcomed us made us feel that it was home.

The guide books are filled with descriptions of things that one must see in Buenos Aires; but the outstanding impression of any city is the atmosphere that it creates for the visitor. In the evening, through the French windows of our room in the hotel, we could see the swaying trees

in the Plaza San Martin, with its live oaks and other green foliage, the lights and shades heightened by the electric lights, and beyond the uniform sky-line of Mansard roofs, all of which made us think of Rome or Paris. In the morning this same Plaza has a renewed fascination, the early riser sitting on a bench in the shade reading his newspaper, the walks being swept, the dew glistening on the leaves of the trees, and the flowers abundant and fresh, and through the branches of the trees a vista of the equestrian statue of San Martin with his outstretched arm urging his warriors on over the Andes. Later in the day as one walks through the broad arched walks of this park the world is awake and hundreds of little children in small groups, with their playthings and their white-garbed attendants, are making a harmonious symphony with their little treble voices, and one soon realizes that there is no race-suicide in this sunlit, Catholic country.

There are many places where one may go and absorb interesting impressions—the Avenida Florida, a shopping street about twenty-five feet wide with three-foot walks on either side, where are the shops, the finest in the city. On this narrow thoroughfare, a mile and a half in length, are many of the principal trading places, the famous Jockey Club, and a number of the palatial residences of the older inhabitants which are gradually being crowded out by the encroachment of business houses. The street is packed with vehicles going single file in either direction until four o'clock in the afternoon, when all traffic is prohibited and the sightseers and shoppers overflow from the side-walks into the street. In this thoroughfare at one time or another one will see everybody worth while in Argentine, and judging from the costumes and faces and languages, any one worth while in the broad world.

At one end of the Avenida, near the small park, are several of the old palatial residences, large iron gates admitting to the court-yards back of the five-story plain fronts being the only signs to indicate that there is habitation within. In one of these lives our friend, Dr. Herrera Vegas, a distinguished surgeon of South America. Beyond the iron gate one sees the patio of growing trees and plants, and the garage. At the side of the entrance is the porter's room where the friend or the stranger is received, inspected, and admitted. The plain walls surround a wealth of comfort and a palatial home. Hence the Avenida Florida, the Fifth Avenue of Buenos Aires, houses many interesting things, and while its reason for being is its wealth of shops, its charm exists in the people who live in it or who come and go to it.

On Sunday afternoons society drives in a section of the boulevard Avenida de Mayo or in one of the large municipal parks. Up and down they ride in a continuous procession, meeting those going in the opposite direction, and at the end of the boulevard turning and repeating the drive. Here in the season, between the hours of five and seven, everybody must be seen. It is the time for the entire family to appear and at its best. I was fortunate in witnessing this wonderful display with an interesting Argentine who could point out and inform me about the people we were seeing.

### *6. El Tigre*

Another impressive and distinctive feature in the environs of Buenos Aires is El Tigre, an interesting freak of nature which transforms a large area of land contiguous to the Rio de la Plata into a group of small islands. Natural waterways, varying from twenty to two hundred feet in width, have made of this area of land and water a symmetrical checker-board, which extends for many miles. On the islands created by the waterways are estates with handsome homes, orchards, flower gardens, wharfs, and bathing places, while in the surrounding channels are myriads of motor boats, row boats, and pretentious yachts. This wonder of nature, twenty miles distant from Buenos Aires, is one of the summer resorts of the metropolis and may be reached by boat, tram car, railroad, or automobile. We were taken in an automobile by Dr. Frank Pasman and Mr. Wilson. The trip made in this way is most enjoyable as it follows more or less closely the river, traverses some interesting towns, and passes many attractive estates. The whole country about this southern city is one beautiful garden in which is grown everything that gladdens the eye and aids in the sustenance of life.

On arriving at El Tigre we visited an attractive Rowing Club and then embarked on a smart little motor boat with a canopy to protect us from the sun. Because of the regularity of the turns, and the symmetrical division of the land into islands without number, one almost duplicating the other, it was difficult to realize that we were traveling otherwise than in a circle as we traversed mile after mile of the water passages. However, each island was a new creation with its distinctive home, its distinctive dock, its distinctive foliage, its distinctive flower garden,

Dr. Alfonso Lamas, Professor of Clinical Surgery, University of Montevideo, Uruguay.

Dr. Juan Pou Orfila, Professor of Clinical Obstetrics, Faculty of Medicine, University of Montevideo, Uruguay

and its distinctive orchard. Often great weeping willow trees obscured the shore line and beyond one caught glimpses of a villa, and at other places peach, plum, quince, or other fruit trees spread their boughs over the water's edge, tempting one to pick and eat.

For two or three wonderful hours we explored this Venice-like territory. Once we disembarked at an island that was owned by a friend of our host. We visited the flower gardens, the vegetable gardens, the vineyards loaded with luscious grapes, the chicken farm, and then the playgrounds and the tennis court. Later in the afternoon we landed at an attractive dock and here, at a little tea house, we sat and had our tea, sandwiches and fruit.

Mr. Wilson then took us to what he called his "shanty," a comfortable bungalow located on one of the smaller islands, where he has everything for which his heart could wish to make life worth living. A large friendly dog met us at the dock. Within the house we were introduced to the Señora and other friends and children, and in the grounds surrounding the house we saw the chicken yard, bee-hives, a vegetable garden, and an abundance of flowers; everything trim and beautifully kept. Each morning after his plunge and his fruit and coffee Mr. Wilson goes to the station in his motor boat as we go to our suburban stations in our automobiles.

El Tigre is one of society's retreats; but the people of the great city are privileged to enjoy the unusual beauty of the place. A large hotel and an amusement pavilion occupy a site on one of the principal waterways near the tram and railroad station, and from here at frequent intervals excursion boats make a tour of the principal water avenues. Our day at El Tigre with our charming hosts was one long to be remembered.

### 7. *An Estancia*

Upon another day we were the guests of Señor and Señora Miles Pasman, whom we found to be most interesting people. They speak English perfectly and have the appearance of substantial New Yorkers. They were both born in Argentine,

but of parents who had but a short time before migrated to that country from New York. Their son, Dr. Rodolfo Pasman, is one of the distinguished surgeons of Buenos Aires, and their nephew, Dr. Frank Pasman, another young surgeon, has recently married one of their daughters. They wondered if we would enjoy an afternoon motor ride to their country place. Our delightful experience of the year before, when we had visited the *hacienda* of Dr. Herrera Vegas, made us anxious to go with our new found friends to this estate, which they so modestly called "a camp." There were two machines, and our ride took us out of the city a distance of about fifteen miles. The "camp" proved to be an estate of many acres with many buildings for the proper care of their large family, places for the care of live stock, a poultry yard, power plants, swimming pools, and tennis courts. In the conservatories are found every modern structure to care for a comprehensive botanical garden, in which not only a specimen of all South American trees and shrubs are housed, but also under careful cultivation many of the plants of other climes, all properly labeled and cared for by an enthusiastic expert head-gardener with an army of helpers.

The house, a charming residence of manor house capacity, located in a large park-like portion of the estate, was one of the surprises of this mere "camp." But the glory of it all came when we began to meet the family. A number of daughters and daughters-in-law were enjoying the hospitality of the "camp"; and then came their children, ranging from babes in arms to dignified young men and women sixteen and seventeen years of age, all glad to see grandfather and grandmother. Everywhere one looked were these attractive grandchildren, each one a beauty, each one with distinctive characteristics, but each one a little aristocrat. Thirty-seven of them there are, and the proud grandfather has a standing offer of a bonus of one thousand dollars in gold to the mother of each additional one, with the stipulation that the bonus is automatically increased until the forty-fifth grandchild will bring a super-handsome solace. What a reproach this family is to our practical, barren people!

Inspection of the estate under the guidance of our enthusiastic host and hostess and their daughters, tea with the delightful grandchildren assisting at the function, good-byes, and the drive back to the city with the automobiles filled with flowers, left us with a picture of the home life of the best people of this purple country that excited our intense admiration.

*8. Zoological Gardens—Señor Clemente Onelli—Señor José Luis Cantilo*

We spent a most interesting afternoon in the Zoological Gardens under the guidance of its founder and director, Señor Clemente Onelli. This wonderful garden has been the life-work of Señor Onelli, and to him the people of Buenos Aires owe an inestimable debt of gratitude. At tea time we were joined by His Excellency, Señor José Luis Cantilo, the Municipal Intendente, a most interesting and agreeable man. He is the chief executive of Buenos Aires, and is untiring in his work for his city, being personally interested in all of its activities, including its hospitals. Later he sent us tickets for a great open-air municipal concert, given on Sunday evening in one of the parks and attended by thousands of people. Both the Intendente and Señor Onelli were most thoughtful and courteous in their attentions to the ladies of our party.

*9. Argentine Jockey Club*

On Sunday, Dr. Robert Halahan took Dr. Watkins and me to the golf club, where we enjoyed playing over a very attractive course. The ladies joined us at luncheon, and later we attended the races at the Argentine Jockey Club. Although it was out of season, the races were most interesting, and we could well imagine how much of a society show-place it is in the height of the season. The race-track, with its comprehensive equipment and club houses, and members' stand of unrivalled beauty, has made the Argentine Jockey Club one of the great sporting clubs of the world. The receipts from this enterprise, over and above the necessary expenses for up-keep, are distributed among well deserving charities.

One naturally visits the Plaza del Congreso, a great court of honor with garden plots, fountains and statues. In one direction, along the Avenida de Mayo, a great thoroughfare carved into the old city, is the President's Palace, and in the other, with an imposing approach, is the National Capitol. (This street was not named for our distinguished surgeons, but for the month of May in which, in 1810, occurred the declaration of independence of Argentine.)

*10. President Hipolito Irigoyen*

I had the privilege of an audience with Dr. Hipolito Irigoyen, the distinguished President of Argentine. My object in visiting the President was to convey to him information about the memorial to General Gorgas which is in con-

templation for Panama. I found my distinguished host very sympathetic to the project, and fully acquainted with the work and reputation of General Gorgas. The President has a very charming personality, a strong physique, and a dark serious face. My interview with him, which was conducted with the Secretary of the American Embassy as interpreter, was extremely interesting and satisfactory, and I felt that I had added one more influential link of friendship to the Gorgas memorial.

On approaching the palace, and while awaiting the time for my appointment, I was particularly struck with the gaudiness and quaintness of the uniforms which are worn by the guards. The Secretary of the Embassy who accompanied me said that these men are the guards of honor to the President; that they belong to the Mounted Grenadiers, a corps that was famous in the time of San Martin, and that they have the privilege of wearing the same type of uniform that was worn by the veterans under that famous warrior in the war for independence.

The many beautiful fountains and groups of statuary scattered throughout the parks and in the open spaces form one of the greatest attractions of the city. At the time of the centennial of the independence of Argentine in 1910, the principal nations of the world presented monuments commemorating the event, and of them the Spanish monument is the most conspicuous, while the United States is represented by a dignified statue of George Washington. However, one seldom sees a vantage point in this beautiful city without something that will appeal to one's artistic taste. There are no bare spots and no glaring defects. Fortunately, nature here embellishes so rapidly with its foliage and its flowers that sordidness and abandoned spots never prevail.

### *11. La Plata*

We visited of course La Plata, the capital of the Province of Buenos Aires. The city itself, like our own Washington, was planned along ambitious lines, and a motor ride through its wide streets lined with palatial government buildings, universities, national museums and other public buildings is much worth while. After driving through the city proper at the time of year when the University is closed one gains the impression that it is an abandoned city. Visiting it, however, as we did last year we gained a happy impression of the capital city and its environs. At that time we were the guests of the Faculty of the University, and were taken in motors from Buenos Aires to La Plata by our friends, the extensive *hacienda* of one of whom we visited on the way. La Plata, from a commercial standpoint is fast becoming famous for its packing houses, established by Americans commonly known as Swift, Armour, Morris, and Wilson.

### *12. Luncheon of American Club*

Everywhere in Buenos Aires one recognizes American and other English-speaking people. Last year Dr. Mayo and I became guests at the weekly luncheon of the American Club of the city. This year Dr. Watkins and I were invited to fill a "return engagement." It was inspiring to meet about three hundred English-speaking business men of Buenos Aires in the large banquet hall of the Plaza Hotel. The group impressed one as would a great human dynamo; scarcely a man among them was over forty-five years of age, and many were very much younger. The southern climate apparently had not changed their natures, as they were alert and clean-cut in appearance. The American Club has assumed the task of acting as a board of censors or credentials on Americans who come to Buenos Aires to do business. Adventurers or dishonest bluffers are not wanted, and there is a genuine desire on the part of this organization to secure for the American business man the respect of the Argentine. And while they are doing business in Argentine, like the Englishman, they remain loyal and devoted to their own country.

We were the guests of this Club on the fourth of March. Therefore, in concluding my short response as their guest I reminded them that at one o'clock when I began my talk a great President of their country had retired from an honored administration. At the mention of Mr. Wilson's name they all arose and applauded for a full minute. At the close of my remarks I said that now a new President had assumed control, and, not as Republicans or Democrats, but as Americans, I suggested that they drink a health to the new President, Mr. Harding, to which they responded with the same enthusiasm as before and arose and drank. One cannot overestimate the influence of an organization like the American Club.

One short week in Argentine is only an aggravation to the visitor. It is a great country with several states, with several large provincial cities, and with a people that are almost as diversified in their interests as are the people of the United States. There is no provincialism manifested in them, nor in the appearance of their institutions. It is one of the principal countries of the world, and it is governed and inhabited by a cultivated, proud, and patriotic people.

### *13. Buenos Aires to Montevideo*

We said adieu to our friends in Buenos Aires, and moved on to Uruguay. Our palatial steamer carried us away from the docks of the metropolis city and we were prepared to again look forward to visiting the capital city of that prosperous and well-governed country.

This entire region is saturated with the romance which it has inherited from the adventurous navigators who so shortly after the discovery of North America explored every river, bay, and harbor of this southern continent, and in an early day sailed into the Rio de la Plata, hoping to find a passage between the continents. As we approached Montevideo by the light of the following day, the first object that came into view was the little mountain from which the settlement that was established here more than five hundred years ago received its name. On this broad river we drifted into the harbor created by superior engineering ingenuity and landed at a modern dock.

## VII. Uruguay

### *1. Montevideo*

Dr. Garcia Lagos, Dr. Enrique Pouey, and Dr. Juan Pou Orfila, three surgeons whose acquaintance we had made last year, were our hosts this morning. They met us at the dock and carried us across the city to our hotel, which faced the sea on the other side of the peninsula. We were comfortably located in pleasant rooms with balconies that overlooked one of the popular bathing beaches.

At three o'clock in the afternoon we were taken for an automobile ride by Dr. and Señora Pou Orfila, who were our gracious hosts on several occasions. Professor Pou Orfila is one of the distinguished gynecologists of Uruguay who, we hope, will honor us with a visit to the United States during the coming year. We drove to Pocitos, one of the beach resorts close to the city, then along a new boulevard that is under construction, and which when finished will skirt the river for many miles. It is called the Rambla Wilson, in honor of ex-President Wilson. At Pocitos the Rio de la Plata is many miles in width and is really an arm of the ocean. A long swell constantly breaks upon its beach, not unlike that of the ocean itself.

In the few days at our disposal in Montevideo, between professional duties, we were very busy visiting the many points of interest. We took a trip to "El Cerro," the famous Spanish fort on the hill, near which has been built the Swift Packing plant. We motored to the new Carasco Hotel which will soon popularize another fashionable beach resort. We drank tea, inspected the beach, watched the roulette players in the attractive casino which is a part of the hotel, and returned home over the Rambla Wilson. It is curious to note that this little progressive Republic recognizes and is indirectly a patron of roulette and other games of chance. Several casinos are conducted, or at least countenanced and licensed, by the municipality of Montevideo, and excess profits from this source are devoted to the maintenance of charitable institutions.

We were anxious to see some of the surgeons at work in their hospitals, and accordingly at seven forty-five on the morning of the third day, Dr. Watkins and I were taken by Dr. Lagos for a clinical visit. Dr. Lagos speaks English perfectly and acted as our official interpreter and guide during our sojourn in Montevideo. He is thoroughly in touch with the medical profession of Uruguay.

### *2. Dr. Alfonso Lamas*

We proceeded to a small private hospital, conducted by Dr. Alfonso Lamas, where we saw him perform the first operation of a two-stage procedure for hydatid cyst of the lung, under local anæsthesia. The pleura opposite the cyst was opened through a trap door created by removing a portion of the rib. An aseptic plastic adhesion was anticipated, a closed track established, and the cyst drained at a later date, à la Bevan's operation for abscess of the lung. Dr. Lamas quoted Dr. Bevan frequently and gave him credit for the idea. This surgeon showed us his record of the case, his X-ray findings, and every evidence of the most careful diagnostic routine. He operates as do all of the South American surgeons whom we have seen, with the French technique. We had nothing but the greatest admiration for the work of this surgeon, and found that he had operated upon a large number of hydatid cysts of the lung which are very prevalent in the southern portion of South America.

### *3. British Hospital—Italian Hospital—Dr. Alfredo Navarro*

Later we went to a well equipped British Hospital where Dr. Lagos does his work; also to a new Italian Hospital, one of the show-places of medical Montevideo, which is built along very artistic lines and is the last word in modern hospital construction. We then visited the large civil charity hospital which is closely connected with the medical department of the University, and saw several operations by Dr. Alfredo

Navarro on an old man who was suffering with acute obstruction of the bowel. The case had been well worked up with elaborate records, laboratory tests, and X-ray findings. Everything about the operating room indicated that good, safe operating was the accustomed routine. The acute obstruction in the patient in question was a complication of a chronic obstruction caused by a neoplasm in the sigmoid. A colostomy was quickly and skillfully performed under high spinal anæsthesia. He then operated on a second case for simple appendicitis. His technique was French, his assistants handing him the instruments, threading needles, and sponging the wounds. This procedure is necessary because they have not the advantage of our nursing organization. However, there was a very efficient helper present in the form of a strong, intelligent woman who brought supplies, hand washes, and did the rough work about the room. Dr. Navarro has an interesting personality and the appearance and actions of our own late Nicholas Senn. A round ligament operation was performed in an adjoining room by two of the assistants in gynecology. The technique was thoroughly up-to-date, and the operation could nowhere in the world have been performed with greater skill.

### *4. President Baltasar Brum*

Through the courtesy of Mr. Robert E. Jeffery, the American Minister to Uruguay, I had the pleasure of an interview with the President, Señor Baltasar Brum, a young man, apparently not more than thirty-five years of age, who possesses a strong and agreeable personality. Dr. Browning, a gentleman to whom I am under great obligation, acted as my interpreter.

My object in seeing the President was to bring to his attention information about the proposed memorial to General Gorgas. As this memorial will undoubtedly take the form of an institute for the study of tropical medicine, he showed a sympathetic attitude.

### *5. Banquet and Reception, Parque Hotel*

A very pleasant diversion and a function that flattered Dr. Watkins and me was a dinner given to us at the Parque Hotel by some of our surgical friends of Montevideo. Our table occupied a conspicuous place in the center of the main dining room and recalled to my mind a similar luncheon that was given to Dr. Mayo and me during our one day's visit the year before.

Later in the evening, in the ballroom of the hotel, a reception was tendered to Mr. Jeffery, our American Minister who was about to return to the United States. We were present and had the pleasure of introducing some of our friends to Mr. Jeffery and the other members of the American Colony with whom we had previously become acquainted.

### *6. Ideal Climate*

Montevideo is located in a semitropical latitude on a peninsula which projects into the southern Atlantic. It enjoys a delightful Summer climate, and lies far enough north to be beyond the frost line, so that the winters cannot be severe. The city is thoroughly modern, and its municipal and national governments are keen to the advantages of modern sanitary regulations. Its water supply is wholesome and pure, its streets are well-paved and clean, and almost the entire circumference at its water's edge is swept by the wholesome waters of an inland sea in the form of a great fresh water river. Our short visit to this city has convinced us that it would be one of the most delightful of South American cities in which to live.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

*Eleventh Annual Session, Philadelphia, October 24-28, 1921*

GEORGE E. ARMSTRONG, Montreal, *President*
JOHN B. DEAVER, Philadelphia, *President-Elect* ALBERT J. OCHSNER, Chicago, *Treasurer*
FRANKLIN H. MARTIN, Chicago, *Secretary-General*

## THE CLINICAL CONGRESS IN PHILADELPHIA

PLANS for the eleventh annual session of the Clinical Congress of the American College of Surgeons to be held in Philadelphia, October 24-28, 1921, are developing rapidly under the supervision of the local committee on arrangements. The general plan of previous sessions will be followed, with operative clinics and demonstrations in the hospitals and medical schools during the morning and afternoon hours of the four days, Tuesday to Friday inclusive, and with scientific meetings each evening in the ballroom of the Bellevue-Stratford Hotel. At the opening session—the presidential meeting—on Monday evening in the ballroom, the John B. Murphy Oration in Surgery will be delivered by Dr. William J. Mayo of Rochester.

A program of clinics and demonstrations that will fully represent the clinical activities of that great medical center is being prepared by an executive committee composed of the following Philadelphia surgeons: George P. Mueller, Chairman; Damon B. Pfeiffer, Secretary; George M. Coates, J. D. Elliott, John H. Jopson, Floyd E. Keene, W. Estell Lee, William T. Shoemaker, J. E. Sweet, and B. A. Thomas.

In this program all departments of surgery will be represented, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat and mouth, experimental surgery, surgical pathology, roentgenology, etc. A preliminary clinical schedule will be published in an early issue.

Clinics and demonstrations are to be given at the following medical schools and hospitals: University of Pennsylvania, Jefferson Medical College, Temple University, Hahnemann Medical College, Women's Medical College, Children's Homeopathic, Episcopal, Frankford, Howard, Jefferson, Jewish, Kensington, Lankenau, Medico-Chirurgical, Methodist, Misericordia, Mount Sinai, Northwestern, Oncologic, Orthopedic, Pennsylvania, Polyclinic, Presbyterian, Philadelphia General, Samaritan, Stetson, St. Agnes's, St. Christopher's, St. Luke's, St. Mary's, St. Joseph's, University, Wills Eye, Woman's, Women's College and Women's Homeopathic Hospitals.

General headquarters for the Congress will be at the Bellevue-Stratford Hotel where the entire first floor has been reserved for the use of the Congress. The large ballroom will be utilized for the evening sessions and for certain clinical demonstrations in the mornings and afternoons. The Clover, Red, Green, and other large rooms and foyers on the same floor will be utilized for registration and ticket bureaus, bulletin rooms.

The ninth annual convocation of the American College of Surgeons will be held in the ballroom on Friday evening at 8 o'clock at which time fellowship in the College will be conferred upon a large group of American and Canadian surgeons, and honorary fellowship upon the distinguished foreign guests.

The annual business meeting of the American College of Surgeons and the Clinical Congress will be held on Thursday afternoon.

An application for reduced railway fares is pending before the Trunk Line Association, and it is expected that the railways will grant a substantial reduction in fares for this meeting. Detailed information with regard to fares and traffic arrangements will be published in later issues.

A series of special clinical demonstrations of interest to general surgeons, presided over by Philadelphia surgeons and participated in by a

number of visiting surgeons, will be presented on Tuesday, Wednesday, and Friday afternoons at 2 o'clock in the ballroom of the Bellevue-Stratford. Similar clinical demonstrations dealing with surgery of the eye, ear, nose, throat and mouth will be given each forenoon.

### LIMITED ATTENDANCE—ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting the attendance, requiring registration in advance on the part of those who wish to attend. A survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools, as to their capacity for accommodating visitors, will be made and the limit of attendance based thereon. This plan insures accommodations at the clinics for all who register in advance, and the necessity for adopting such a plan will be apparent to all. Based upon our experience at previous meetings, it is probable that the limit of attendance will be reached weeks in advance of the meeting, hence the necessity for early registration, for when the limit of attendance has been reached through advance registration, no further applications can be accepted. Attendance at all clinics, demonstrations, and scientific sessions will necessarily be restricted to those surgeons who have registered for the Congress.

### CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, the number of tickets issued for any clinic or demonstration being limited to the capacity of the room in which the clinic or demonstration is to be given. As a general rule, one may secure two tickets for each day, one for a morning and one for an afternoon clinic, but for certain clinics, where the accommodations are limited and the demand for tickets is heavy, the rule will be that a visitor may have but one ticket for such clinic during the week. The use of these tickets has proven an efficient means of providing for the distribution of visitors among the several clinics and insures against overcrowding.

Clinic tickets will be issued at headquarters each morning at 8 o'clock for the clinics and demonstrations to be given that day, except that for Tuesday's clinics the tickets will be issued on Monday afternoon as the visiting surgeons register. A complete schedule of the day's clinics will be posted on bulletin boards at headquarters during the afternoon of the preceding day. After the program has been posted reservations for tickets for the next day's clinics may be filed, the tickets to be issued the next morning. Printed programs will be issued each morning containing the complete clinical program for the day, with announcements of the evening sessions, business meetings, etc.

### REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, the receipts from registration fees providing the funds with which to meet the expenses of conducting the meeting, so that no financial burden is imposed upon the members of the profession in the city entertaining the Congress.

A formal receipt for the registration fee is issued to each surgeon registering in advance, which receipt is to be exchanged for a general admission card at headquarters upon his arrival in Philadelphia. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings.

Headquarters at the Bellevue-Stratford Hotel will be open for registration on Monday, October 24. The clinical program for Tuesday will be bulletined at headquarters on Monday afternoon and tickets for Tuesday's clinics will be issued as visiting surgeons register.

# STATE CLINICAL MEETINGS

MEETINGS of state sections of the Clinical Congress of the American College of Surgeons were held during May for the state of Indiana at Indianapolis, May 2 and 3; for Maryland and the District of Columbia, Baltimore, May 10, and Washington, May 11; for Massachusetts at Springfield, May 13 and 14. At each meeting there were clinical, scientific, and public sessions and a hospital conference on standardization. The programs follow:

## INDIANA

### Monday, May 2

*Clinics*

At the Indianapolis City, Methodist, and St. Vincent's Hospitals, 9 a.m. to 12 m.

*Hospital Conference, 2:30 p.m.*

Miles F. Porter, M.D., Chairman, Indiana State Section, presiding.
The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—Richard B. Wetherill, M.D., LaFayette.
Experience with the Standardization Program of the American College of Surgeons, from the Hospital Superintendent's Standpoint—H. L. Foreman, M.D., Superintendent, Indianapolis City Hospital.
Discussion—Opened by Miles F. Porter, M.D., Fort Wayne.
General Discussion.
Annual Meeting of the Indiana Section of the Clinical Congress of the American College of Surgeons.

*Public Meeting, 8.00 p.m.*

Miles F. Porter, M.D., Chairman, Indiana State Section, presiding.
Address of Welcome—Honorable Charles Jewett, Mayor of Indianapolis.
The American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Surgeon and the Community—William D. Haggard, M.D., Professor of Surgery, Vanderbilt University, Nashville.
The Early Recognition of Cancer and Its Importance—Carl A. Hamann, Professor of Clinical Surgery, Western Reserve University, Cleveland.
What the Public Should Know about Cancer—Joseph C. Bloodgood, M.D., Associate Professor of Clinical Surgery, Johns Hopkins University, Baltimore.
The Standardization of Hospitals—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

### Tuesday, May 3

*Clinics*

At the Indianapolis City, Methodist, and St. Vincent's Hospitals, 9 a.m. to 12 m.

*Scientific Session, 2:30 p.m.*

Organization for Better Surgery—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
Present Status of the Cancer Problem — William D. Haggard, M.D., Nashville.
Clinical Resemblance between Inflammatory Processes and Neoplasm—Carl A. Hamann, M.D., Cleveland.

## MARYLAND AND DISTRICT OF COLUMBIA

### Tuesday, May 10, Baltimore

*Clinics*

At Johns Hopkins Hospital, 9 a.m. to 12 m. and University of Maryland Hospital, 1:30 to 4:30 p.m.

*Scientific Session, 8:30 p.m.*

Organization for Better Surgery—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Relation of Disease of the Pelvic Organs in the Female to that of Other Abdominal Viscera—John B. Deaver, M.D., Philadelphia, President, American College of Surgeons.
Vesiculitis as a Focal Infection (illustrated by lantern slides)—J. H. Cunningham, M.D., Boston.
Spasmodic Porticollis—J. M. T. Finney, M.D., Baltimore

### Wednesday, May 11, Washington, D. C.

*Clinics*

At the Columbia, Emergency, Garfield, Providence, U. S. Naval, Walter Reed, and Episcopal Eye, Ear, and Throat Hospitals, 9 a.m. to 12:30 p.m.

*Hospital Conference, 3 p.m.*

J. Wesley Bovee, M.D., Chairman, District of Columbia Section, presiding.
The Hospital Program of the American College of Surgeons and the Meaning of the Minimum Standard—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Program of the American College of Surgeons as Applied to Catholic Hospitals—Reverend C. B. Moulinier, S. J., President, Catholic Hospital Association.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—Colonel W. C. Borden, M.C., U.S.A., Washington.
Experience with the Standardization Program of the American College of Surgeons, from the Hospital Superintendent's Standpoint—Mr. J. R. Mays, Superintendent, Garfield Hospital, Washington.
Discussion—Opened by Colonel W. H. Arthur, M.C., U.S.A. (Retired), Washington.

*Public Meeting, 8:15 p.m.*

J. Wesley Bovee, M.D., Chairman, District of Columbia Section, presiding.
Address of Welcome—Honorable Henry B. F. Macfarland.
The American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
Scientific Research and Its Advantages to the Community—John B. Deaver, M.D., Philadelphia, President, American College of Surgeons.
The American College of Surgeons and Its Relation to Public Welfare—Brigadier-General Charles E. Sawyer, M.C., U.S.A., Washington, Second Vice-President, American College of Surgeons.
Better Hospitals—Reverend C. B. Moulinier, S. J., President, Catholic Hospital Association.
The Standardization of Hospitals—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.

## MASSACHUSETTS

FRIDAY, MAY 13

*Clinics*

At the Mercy, Springfield, Wesson Memorial, and Wesson Maternity Hospitals, 10:30 a.m. to 12:30 p.m.

*Hospital Conference, 2:30 p.m.*

Hospital Standardization—Homer Gage, M.D., Worcester.
The Hospital Program of the American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Work of the Hospital Surveyor—James L. Smith, M.D., Hospital Survey Department, American College of Surgeons.
The Meaning of the Minimum Standard—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
The Program of the American College of Surgeons as Applied to Catholic Hospitals—Reverend C. B. Moulinier, S. J., President, Catholic Hospital Association.
Maternity Benefit Legislation—B. W. Paddock, M.D., Pittsfield.
Discussion—By Philemon E. Truesdale, M.D., Fall River, and Mr. W. C. Lyon, Superintendent, Springfield Hospital, Springfield.

*Public Meeting, 8:15 p.m.*

Introductory Address—William W. McClench, Esq.
The American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
Better Hospitals—Reverend C. B. Moulinier, S. J., President, Catholic Hospital Association.
The Standardization of Hospitals—Judge Harold M. Stephens, Director of Hospital Activities, American College of Surgeons.
Economic Value to the Community of Pre-Natal Work—John Osborn Polak, M.D., Brooklyn.

SATURDAY, MAY 14

*Clinics*

At the Mercy, Springfield, Wesson Maternity, and Wesson Memorial Hospitals, 9:30 a.m. to 12:30 p.m.

*Scientific Session, 2:30 p.m.*

The Relation of Animal Experimentation to Medical Progress—W. B. Cannon, M.D., Boston.
From the Inside, Looking Out—R. H. Seelye, M.D., Springfield.
Cancer—Joseph C. Bloodgood, M.D., Baltimore.
A Study of 307 Cases of Ectopic Pregnancies—John Osborn Polak, M.D., Brooklyn.

MEETINGS TO BE HELD

North Dakota—Bismarck, June 24 and 25.
South Dakota—Aberdeen, June 27 and 28.

# CORRESPONDENCE

## A NEW METHOD OF TYING A SURGICAL KNOT

*To the Editor:* In May, 1918, SURGERY, GYNECOLOGY AND OBSTETRICS published my paper entitled, "A New Method of Tying a Surgical Knot."

In that article I said: "The credit of the idea of using forceps instead of fingers should be given, I believe, to Dr. A. L. Soresi, of New York, now serving with great distinction in the Italian army. Dr. Soresi published an article several years ago describing a method of making a knot when the suture had been broken off. Surgeons use forceps in certain cases, but I find nothing in the literature describing this method and its universal application."

My attention has been called to the fact that Dr. Soresi's paper referred to was published in the *American Journal of Surgery*, for March, 1911, and was entitled "A Means of Tying Knots Even When One End of the Suture is Very Short."

The credit of the idea should, therefore, be given Dr. Soresi.

My method of procedure and its universal application to all varieties of knots and ligatures furnishes a technique that is practicable to right-handed surgeons.

A. R. GRANT.
UTICA, N. Y.

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

KEEN'S SURGERY: ITS PRINCIPLES AND PRACTICE. By various authors. Edited by William Williams Keen, M.D., LL.D. Vol. viii and index. Philadelphia and London: W. B. Saunders Co., 1921.

UEBER DIE ENTWICKLUNG UND DEN AUSBAU DER SUPRASYMPHYSÄREN SCHNITTENTBINDUNG AN DER UNIVERSITÄTS-FRAUENKLINIK TÜBINGEN. By Dr. Emil Vogt. Berlin: S. Karger, 1921.

DIE THERAPIE DER PLACENTA PRÆVIA. By Professor Dr. F. Hitschmann. Berlin: S. Karger, 1921.

TREATISE ON FRACTURES IN GENERAL, INDUSTRIAL, AND MILITARY PRACTICE. By John B. Roberts, A.M., M.D., F.A.C.S., and James A. Kelly, A.M., M.D. Philadelphia and London: J. B. Lippincott Co., 1921.

ANNUAL REPRINT OF THE REPORTS OF THE COUNCIL ON PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION, FOR 1920.

PSYCHOPATHOLOGY. By Edward J. Kempf, M.D. St. Louis: C. V. Mosby Company, 1920.

THE PRACTICAL MEDICINE SERIES. Vol. ii. Edited by Albert J. Ochsner, M.D., F.R.M.S., LL.D., F.A.C.S. Chicago: The Year Book Publishers, 1920.

OPERATIVE SURGERY; FOR STUDENTS AND PRACTITIONERS. By John J. McGrath, M.D., F.A.C.S., 6th ed. revised. Philadelphia: F. A. Davis Company, 1921.

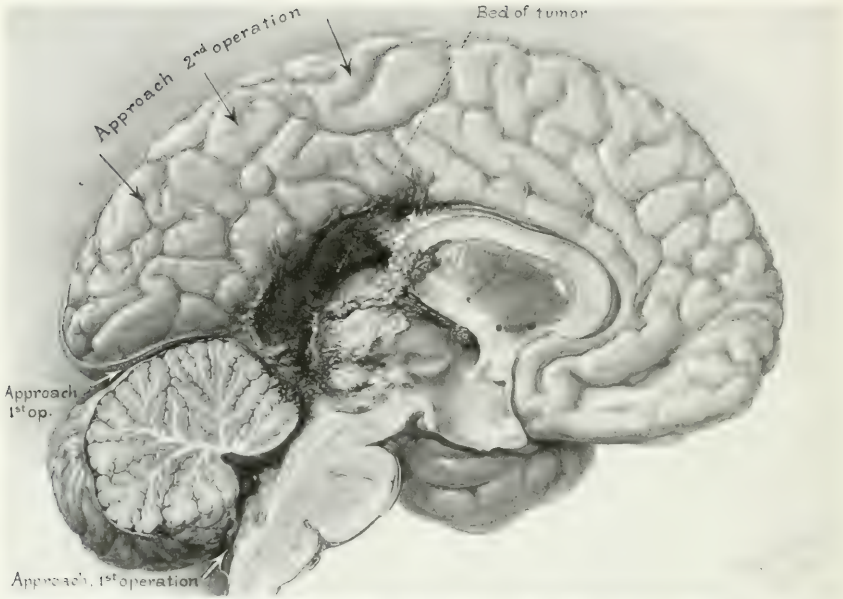



Fig. 10.—Drawing of mid-sagittal view of brain from which a pineal tumor was removed. The bed from which the tumor was removed shows its location and relative size. The tumor was exposed first by following up the fourth ventricle. It was then exposed by an approach over the cerebellum and under the tentorium but the removal was seen to be possible only by operative procedure just described.

*An Operation for the Removal of Pineal Tumors.*—*Walter E. Dandy.*

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXXIII AUGUST, 1921 NUMBER 2

# AN OPERATION FOR THE REMOVAL OF PINEAL TUMORS

BY WALTER E. DANDY, M.D., BALTIMORE
From the Department of Surgery, The Johns Hopkins Hospital and University

TUMORS of the pineal body have rarely been diagnosed and substantiated. The total number of authenticated pineal tumors is less than one hundred and almost all have been accidental findings at necropsy. In most instances the clinical diagnosis of a pineal neoplasm has been made upon inadequate and fallacious observations and deductions and a totally different lesion has been found at necropsy. But it is now possible to make a correct diagnosis of this lesion; at times the exact diagnosis cannot be made but the lesion can be restricted to the mesencephalon with the pineal growth the highest probability. Naturally the absence of a correct localization of this lesion has precluded any operative interference with this region, and with the advent of accurate localization, the need of a practical surgical approach for the enucleation of pineal tumors is imperative. It is the purpose of this paper to introduce such an operative procedure. The diagnosis of tumors of the pineal body will be withheld for a subsequent communication.

Several years ago I evolved an operative procedure by which it was possible to remove the pineal body in dogs.[1] The operation as finally developed could be conducted without mortality and without any noticeable after-effect upon the well-being of the animal and resulted in no apparent mental or physical change. The operation which is presented here for patients suffering with pineal tumors is very similar to this canine operation.

The operation has been performed on three patients. In the first instance a silent cerebellar tumor had secondarily involved the region of the pineal body and the corpora quadrigemina; after exposure of the tumor, no attempt was made to remove it, because of its infiltrating character. This case, however, showed that a good exposure of this region is possible. On two subsequent occasions, tumors of the pineal body have been completely removed. In one case an encapsulated tubercle of the pineal body was extirpated, the patient recovering only to die 8 months later, presumably of the effects of other tubercles of the brain, although as he was then at home no necropsy was obtained. After the removal of the tubercle, however, the signs by which his lesion was located quickly disappeared. The gross appearance of this growth at the time of operation suggested an endothelioma and it was only subsequently that the microscope revealed its true nature to be a tubercle. It was hard, nodular, and perfectly encapsulated; it measured 5 centimeters by 4 centimeters. The results of this case demonstrated not only the feasibility of the removal of tumors of the pineal body but also the absence (in this case at least) of any injurious mental or physical effects due to the operation.

[1] Extirpation of the pineal body. J. Exper. Med., 1915, xxii, 237.

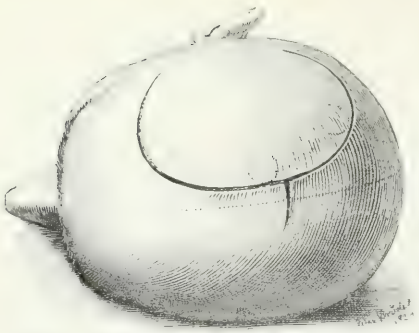


Fig. 1. The skin incision and the openings for the bone flap are outlined permitting a thorough exposure of the posterior two-thirds of the cerebral hemisphere. The incision extends almost to the mid-line and is made large enough to permit exposure of the posterior two-thirds of the cerebral hemisphere.

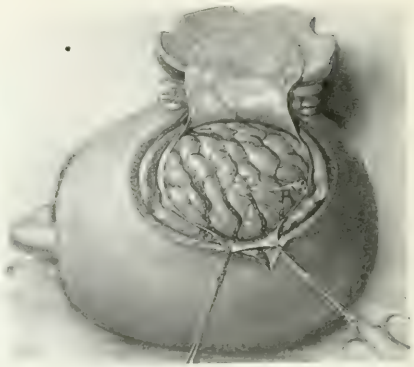


Fig. 2. . The bone flap is turned back and the cerebral hemisphere exposed mesially to the superior longitudinal sinus. A puncture of the lateral ventricle reduces the intracerebral pressure and consequently the volume of brain in the field of operation.

The extirpation of the second pineal tumor was very much more difficult. The tumor was much larger and since the vena Galena magna and both small veins of Galen passed directly through the tumor and could not be dissected from it, the removal of practically all of these veins was a prerequisite to enucleation of the tumor. This tumor weighed 26 grams. It was very hard, fairly nodular, and perfectly encapsulated. It required a painstaking dissection to free the growth from the extensive vascular attachments, but it was finally readily lifted from its bed without any bleeding. The patient lived 48 hours, dying presumably of the shock due to the magnitude of the operation. His vitality was doubtless impaired by a cerebellar operation which was performed 10 days previously and at which the tumor was found; but it was entirely inaccessible for removal by this approach. One can, of course, only wonder whether there might have been a different outcome had his full strength been retained. One must also consider whether the complete removal of all the main trunks of the intracranial venous system—the large vein of Galen and both small veins of Galen—would be compatible with life. I know of no previous instance in which these veins have been removed or even ligated. In dogs I have ligated the vena Galena magna without effect when the ligation is distally placed but when proximally placed a mild grade of hydrocephalus has resulted. In this case, however, at least 7 centimeters of this vascular trunk on either side were removed. Whether the collateral venous system in the human brain could be developed to compensate for this tremendous loss can only be surmised; it does seem doubt-

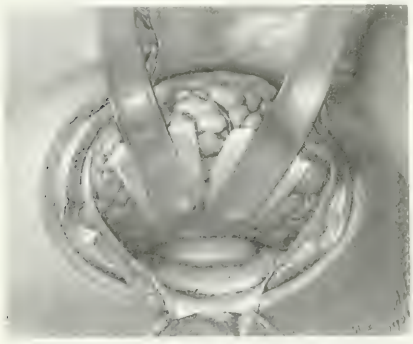


Fig. 3. The cerebral hemisphere is retracted exposing the corpus callosum and the falx. Note the ligated stumps of the cerebral veins as they enter the superior longitudinal sinus.

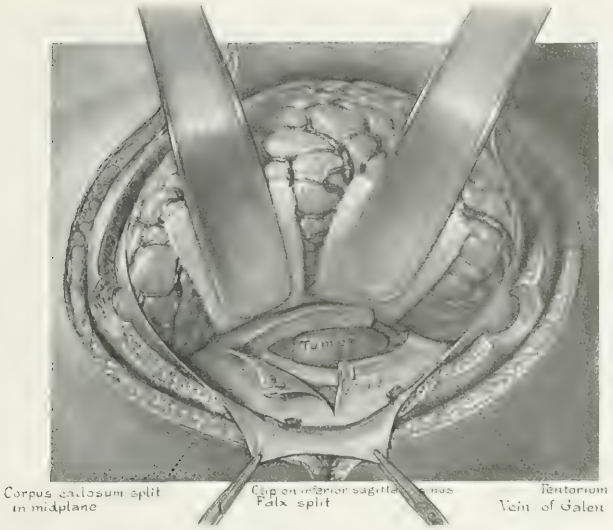



Fig. 4. The corpus callosum has been divided longitudinally exposing the tumor of the pineal body and the entire length of the vena Galena magna and the terminus of each small vein of Galen. Note the divided falx and inferior longitudinal sinus.

ful, but there was no alternative to the removal of these veins with the tumor.

### THE TREATMENT OF PINEAL TUMORS

Tumors of the pineal body can be helped by only one form of therapy, i.e., operative removal. Any treatment which is less than this can have no possible value. The symptoms which bring the patient to the physician are invariably those of intracranial pressure due to an internal hydrocephalus which is caused by occlusion of the aqueduct of Sylvius directly over which the tumor is situated. Other signs of local character follow the direct pressure of the tumor upon the corpora quadrigemina and upon the structures in the mesencephalon. There can be no relief of the hydrocephalus except by removal of the obstructing lesion. No palliative benefits can possibly accrue from a decompression or from the too oft performed puncture of the corpus callosum. A decompression removes an area of bone which is nature's only protection against the tremendous intraventricular pressure and local cerebral injury must follow at the operative area and without any possible compensatory benefit to the afflicted individual. A callosal puncture admits of no relief because the fluid released absorbs with no greater rapidity in the subdural space, into which it passes, than in its former habitat in the ventricle; moreover, the opening remains patent only for a brief period, closing as all non-epithelialized cerebral wounds must do owing to the reparative processes of the neuroglia.

The operation, therefore, which I am about to propose is designed to remove the tumor directly. The accompanying drawing and diagram by Mr. Brœdel clearly show the various stages in the operation. The approach to the tumor is made possible by a very large parieto-occipital bone flap (Fig. 1), the mesial margin of which extends to the superior

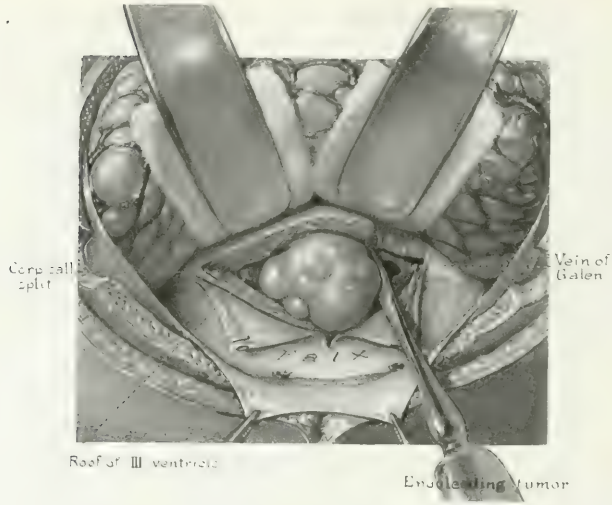



Fig. 5. Demonstrates the enucleation of the encapsulated pineal tumor. This particular growth was a tubercle of the pineal.

longitudinal sinus. The exposure of this sinus (Fig. 2) is frequently a relatively bloody procedure because of the venous lakes, which are usually both large and numerous and the control of hæmorrhage must be quick and effective. If the bone flap does not extend to the mid-line a secondary defect must be rongeured away from the mesial margin of bone until the sinus is reached. The dura is then opened and reflected over the inferior longitudinal sinus. In doing so, the cerebral veins which bridge the subdural space between the brain and the longitudinal sinus are gradually elevated, doubly ligated with fine silk ligatures, and divided (Fig. 2). The number of these veins in the necessary field of operation varies from one to six or even more. It is well if possible to avoid ligature of the Rolandic vein for a transient hemiplegia will follow. Usually, however, it is necessary to ligate all the veins posterior to the Rolandic vein. It is hardly necessary to add that for this reason and because of possible speech disturbances, the craniotomy should be performed on the right side; and because tumors of the pineal body are always in a strictly central position, exposure of the growth is equally easy on either side. In the case in which the

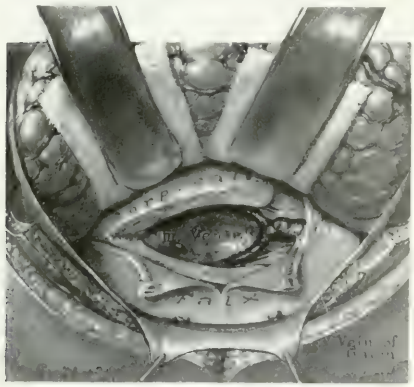


Fig. 6. After removal of the tumor the roof of the third ventricle in this case remained intact and the large vein and the two small veins of Galen are brought into view. The large vein is quite tortous; the two small veins unduly separated by the growth between them.

Fig. 7. Drawing of the large pineal tumor in position when thoroughly exposed and just before its enucleation. Note the ligatures on the large vein of Galen and on each small vein of Galen. The veins pass directly through the tumor. The growth has pushed the third ventricle well forward.

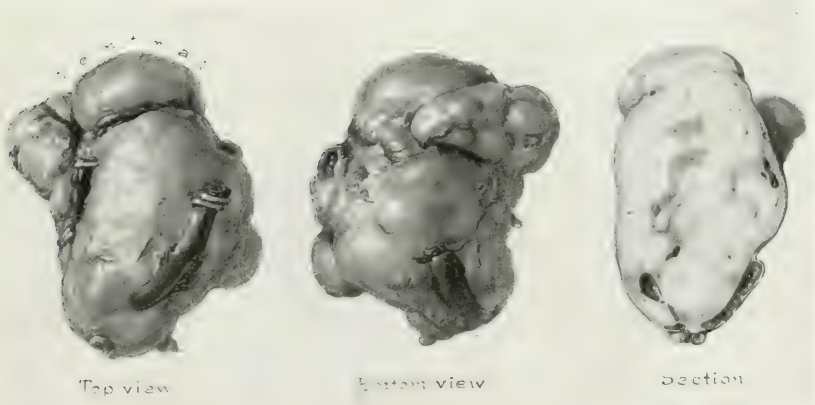



Fig. 8. Drawings of the pineal tumor, reduced one twelfth, showing actual shape and appearance on section. Note the veins of Galen clinging to the tumor.

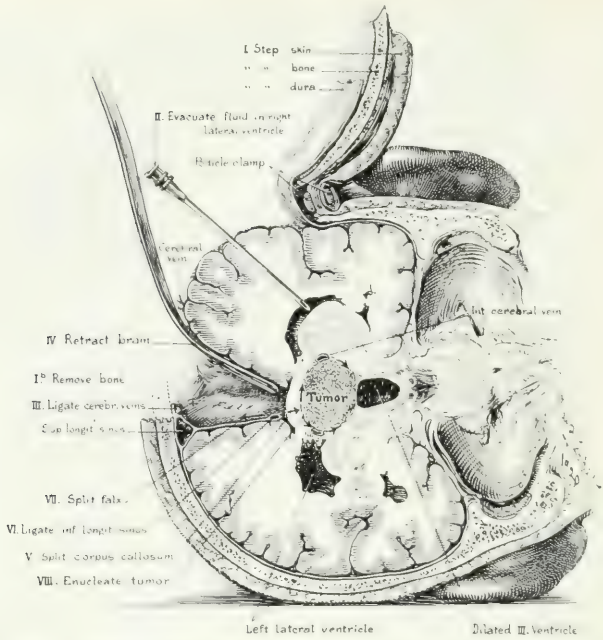



Fig. 6. Diagram by Mr. Broedel showing the various steps in the operation. The labeling adequately tells the operative story.

tubercle was removed, the tumor was approached from the left side because a deforming operation had been previously performed on the right. No speech disturbances followed in this case, although there was a weakness of the right side for several days.

After division of the cerebral veins the entire posterior half of the cerebral hemisphere can be retracted and the falx exposed. The inferior longitudinal sinus is quickly passed and the corpus callosum brought into view as the brain is still further retracted (Fig. 3). This part of the operation is bloodless and is quickly and easily accomplished. Until now there is no evidence of an underlying tumor. The posterior half of the corpus callosum is then carefully incised in the mid-line (Fig. 4) for a distance of 3 or 4 centimeters and the hemispheres still further retracted. The tumor will then be brought into full view. Under the fornix of the corpus callosum the vena Galena magna will always be brought into full view at its entrance into the sinus rectus (Fig. 5). In one of the cases here reported, the tumor lay anterior to the large vein of Galen and between it and the corpus callosum. In the other case about one-half centimeter of the great vein of Galen was free between the upper margin of the tumor and the beginning of the sinus rectus, an amount sufficient to permit double ligation and division of the vein between the ligatures. In the first case the tumor tubercle stripped readily from the vein (Fig. 5), and no bleeding resulted from the dissection. After the tumor was extirpated the great vein of Galen was seen as a tortuous trunk which when straightened would probably measure 4 centimeters

in length; the third ventricle was not opened during the enucleation of the tumor. The bed from which the tumor was removed was the roof of the third ventricle and its appearance was exactly like the photographs seen in text books showing the small vein of Galen on either side of the mid-line running a straight longitudinal course of probably 5 centimeters before they were again lost in the substance of the brain (Fig. 6).

In the second case the tumor was so large that an adequate exposure was obtained only by dividing the falx cerebri (and with it, of course, the inferior longitudinal sinus, Fig. 7). It was then possible to retract the brain to both sides. Each small vein of Galen was carefully dissected where it crossed from the tumor to the brain and divided between silk ligatures. Several small tributaries of these veins were separately tied and divided as they emerged from the tumor. No dissection was made blindly; the tumor (Fig. 8) was gradually enucleated with ease. During the removal of this tumor the third ventricle was opened and the tumor extended so deeply that the operator's finger reached the posterior clinoid process of the sella turcica. It will be evident from the ability to tie ligatures at this great depth (Fig. 10, frontispiece) and from the deep dissection of tumor which lay immediately over posterior clinoid process that operative exposure is probably sufficient. A great deal of this room is afforded by the release of fluid from the lateral ventricle by a puncture early in the operation. The hydrocephalus while so destructive of brain tissue has it compensating benefits in the amount of fluid which can be released thus allowing the reduced bulk of brain to be easily retracted from the operative field. Were it not for the release of fluid not only would the exposure of the tumor be very difficult but the necessary retraction of the brain would be very injurious to the cerebral hemisphere.

# JEJUNAL ULCER[1]

By E. S. JUDD, M.D., F.A.C.S., Rochester, Minnesota

GASTROJEJUNOSTOMY for ulcer of the stomach or of the duodenum offers the patient a good prospect of complete and permanent relief of all symptoms. Because of the frequency of malignancy of the stomach and because a greater proportion of gastric ulcers is cured if the ulcers are excised in addition to gastro-enterostomy, excision should always be performed. In duodenal ulcers, either gastro-enterostomy, or excision is sufficient.

Unsatisfactory results are most often due to a gastrojejunostomy in cases in which no ulcer exists. The basis for the operation in these cases is the clinical history and either no attempt is made to demonstrate the ulcer or it is assumed that an ulcer is present when none can be located. As a matter of fact, an ulcer of the stomach or of the duodenum is seldom present without being demonstrable. More often the cause of the symptoms is located elsewhere which is further justification of a very good rule not to operate unless an ulcer can be demonstrated beyond a question of doubt. The fundamental basis for surgical procedures must be pathological and not clinical. The so-called vicious circle is now seldom heard of although a few years ago it was a much dreaded complication in these cases. The disappearance of this syndrome has been brought about partly by improvement in technique, but more particularly by the recognition of the importance of avoiding operation when no ulcer exists.

The particular phase of ulcers that I wish to discuss is the formation of secondary ulcers some time after the operation. Jejunal ulcer is one of the most serious and perhaps one of the most common after-complications of gastro-enterostomy. It occurs either in the line of anastomosis as a so-called gastrojejunal ulcer, or in the jejunum below the line of anastomosis as a true jejunal ulcer. The lesion is usually single, although multiple ulcers at the site of the anastomosis are not uncommon. In such ulcers the lesion in the mucous membrane is usually very small and, I believe, is always entirely limited to the intestinal side. The presence of œdema and adhesion to the surrounding tissues is marked and suggests that in most of these cases there has been a slow leak from a small perforation. The lesion of the mucous membrane, although it is entirely within the mucosa of the small intestine, is most often very close to the gastric mucosa. In all of the cases in the clinic the lesion seemed to be distinctly jejunal. This differs from Paterson's report of cases, for he says that in most instances the ulcer is some little distance from the stoma. Often it is situated directly opposite the opening in the stomach and nearly always in the efferent loop; it may be fully 10 centimeters from the anastomosis.

The frequency with which jejunal ulcers occur following gastro-enterostomy is difficult to estimate; Paterson reports that they occur in from 1 per cent to 2 per cent of cases. In the clinic we have found 55 definite secondary ulcers in 4,324 gastro-enterostomies, but in all probability the percentage is somewhat higher because in some instances the disturbance from the ulcer may not be sufficient to bring the patient back for treatment and, furthermore, with the return of symptoms he is likely to seek treatment elsewhere. Thus we may not see all of our patients who develop the condition. We have operated on 46 patients for jejunal ulcer in whom the primary operation had been performed elsewhere.

## ETIOLOGY

A satisfactory explanation of the cause of jejunal ulcer can best be found in the etiology of the original ulcer. In not a single case in our experience did an ulcer of the jejunum occur as a primary lesion, and we have found but one case mentioned in the literature—that reported by Schmilinsky in a patient 63 years of age who had a chronic ulcer of the jejunum which was resected. In the

[1] Presented before the Association of Surgeons of St. Louis, January, 1921

Fig. 1. (66081.) Jejunal ulcer showing gastrocolic fistula at *p*.

Fig. 2. (98054.) Jejunal ulcer. *s*, Deformity of stoma; *j*, narrowing of first part of the jejunum.

discussion of this report Frankel and Katz stated that they had seen a similar case but that they had attributed the ulcers to syphilis. Schmilinsky concluded that his case might have been syphilitic in origin, although he had no proof of this. At any rate, if jejunal ulcer occurs at all as a primary lesion it is extremely rare. It is interesting to note that jejunal ulcer following operation almost always occurs only following gastro-enterostomy for ulcer. One case has been observed in the Mayo Clinic following resection of the stomach for cancer. There are no cases following plastic procedure around the pylorus.

Undoubtedly the principal cause of the secondary ulceration is the action of the acid gastric secretion on the mucous membrane of the jejunum. In most cases of ulcer there is a hyperacidity or hypersecretion and unless this is neutralized by the bile and pancreatic secretions it may have a very toxic and destructive influence on the epithelium of the intestine. In all of Paterson's cases and in more than 60 per cent of the cases in the clinic the acids were high even after gastro-enterostomy. In the ordinary case the acid chyme is neutralized as it enters the intestine by the action of the bile and pancreatic fluids. If, however, there is any unusual change in either the amount or rate of secretion of the acid fluids of the stomach, or any change in amount, or rate, or character of the secretion of bile or pancreatic juice the neutralizing influence may be destroyed, and the contents of the jejunum may become strongly acid. Undoubtedly it is some such disturbance which allows the un-neutralized acid chyme to reach the jejunum and to afford an opportunity for the formation of jejunal ulcer.

Permanent suture material has also been a factor in the production of many ulcers, particularly those close to the gastrojejunostomy opening. In the clinic large strands of silk and linen have been found hanging from the ulcerated area several years after the operation and undoubtedly this foreign material had kept up irritation and infection. In the series of 101 jejunal ulcers in the Mayo Clinic, herewith reported, nonabsorbable suture material was found in 9 cases of the 55 in which the primary operation was performed in the clinic, and in 17 of the 46 in which the primary operation was performed elsewhere (Table 1). Recently Dr. Sistrunk cut off a gastro-enterostomy for a patient operated on 12 years before. Heavy black silk sutures were found but no evidence of infection or ulceration; nevertheless, it seems reasonable to assume that since nonabsorbable material has been discarded, fewer jejunal ulcers will develop.

TABLE I.—JEJUNAL ULCERS FOLLOWING GASTRO-ENTEROSTOMY IN 101 CASES

Mayo Clinic, January 1, 1912, to January 21, 1921.

| | Cases | |
|---|---|---|
| Males | 69 | |
| Females | 32 | |
| Ulcers at the stoma | 93 | |
| Ulcers below the stoma | 8 | |
| No evidence of primary ulcer | 15 | |
| Foreign material found at secondary operation | 6 | |
| Foreign material found at secondary operation but not in vicinity of the ulcer | 3 | |
| Primary operation (Mayo Clinic) | 55 | |
| Foreign material found at secondary operation | 9 | (16.25 per cent) |
| Primary operation (elsewhere) | 46 | |
| Foreign material found at secondary operation | 17 | (37.77 per cent) |
| *Type of second operation* | | |
| Excision and cutting off of gastro-enterostomy | 28 | |
| Excision and reconstruction of gastro-enterostomy | 16 | |
| Excision and cutting off of gastro-enterostomy | | |
| a. New gastro-enterostomy (one anterior) | 11 | |
| b. New gastro-duodenostomy (one anterior) | 12 | |
| Partial gastrectomy | 8 | |
| Excision of ulcer and plastic operation | 16 | |
| Excision of ulcer and pyloroplasty | 10 | 101 |

| | | |
|---|---|---|
| *Findings at secondary operation* | | |
| Large ulcers (10 perforated and 2 associated with hourglass stomach) | 30 | 6 hard |
| Small ulcers (3 perforated) | 42 | 10 calloused |
| Small acute ulcers | 4 | |
| Perforations (no mention of type of ulcer) | 11 | |
| Indurated ulcers | 2 | |
| Type of ulcer not classified | 12 | 101 |
| Marked stricture of the jejunum | 3 | |
| Dilated jejunum | 2 | |
| Œdema | 8 | |
| Linitis plastica | 1 | |
| Marked obstruction | 8 | |
| Adhesions of variable degree | 54 | |
| *Additional procedures at time of secondary operation* | | |
| Appendectomy | 10 | |
| Cholecystectomy (one with pyloroplasty | 4 | |
| Knife excision of old duodenal ulcer | 9 | |
| Cautery excision of old duodenal ulcer | 1 | |
| Herniotomy | 5 | |
| Adhesions broken up | 13 | |
| Partial gastrectomy with anastomosis for polypoid carcinoma and duodenectomy for duodenal ulcer | 1 | 43 |
| Gastro-enterostomies for benign ulcer from January 1, 1912 to January 1, 1921 | 4324 | |

Trauma to the tissues of the jejunum during the operation must be considered a factor in the formation of some ulcers. It has been contended that the use of rubber-guarded clamps on the stomach and jejunum is a cause, but ulcers have been reported when these were not used and it has also been shown that often the jejunal ulcer forms in the part of the efferent loop below the clamps; in 8 of the series of 101 jejunal ulcers, the lesion was several centimeters from the anastomosis; in one case it was 10 centimeters.

Infection must play some part in the etiology of these lesions. The cut surfaces of the stomach and of the jejunum are exposed to the infection from the original ulcer during operation and during the healing process which lasts about 14 days. It is questionable whether or not infection from the surface of the ulcer carried to the freshly cut area would result in the same type of lesion. Furthermore, in 15 of the 101 cases there was no evidence of an original ulcer. Moynihan mentions two such cases. The gastro-enterostomy had been performed for other conditions such as dilation or prolapse so that infection from the ulcer was not present at the time of the operation. This seems to show that a particular type of infection is not necessary for the formation of the secondary ulcer.

### CLINICAL MANIFESTATIONS

The time of onset of symptoms of jejunal ulcer varies from almost immediately after the gastro-enterostomy to 8 or 10 years. In one of our cases there was relief for a very short time and then a return of all the symptoms, and within 5 weeks after the original operation a definite secondary ulcer was demonstrated by the roentgen-ray examination. The second operation, performed at that time, revealed a jejunal ulcer much larger than the original duodenal ulcer. This case also illustrates what seems to be a tendency to ulcer-forming found in an occasional patient. After the second operation, which

Fig. 3. (108030.) *s*, Deformity of stoma; *j*, narrowing of jejunum in a case of jejunal ulcer.

Fig. 4. (112391.) *s*, Deformity of stoma; *j*, narrowing of the jejunum near stoma in a case of jejunal ulcer.

was excision of the jejunal ulcer and plastic re-establishment of the gastro-enterostomy, the patient was placed on definite ulcer management in which he had been trained for a year previous to the first operation. He remained free from symptoms for 3 months and then had a return of all of the signs and symptoms of a jejunal ulcer which was again demonstrated by the roentgen-ray. At the third operation, just 3 months after the first, a jejunal ulcer was found on the afferent side of the stoma, which was opposite the location of the former jejunal ulcer. At this time the gastrojejunostomy was undone and the duodenal ulcer excised. The patient has now been free from symptoms for about 2 years. Several cases similar to this one have been reported, and even three or four operations for recurring ulcers have been performed. A detailed study of the blood of the patient was made and a thorough examination of the foci for any source of infection, but reason for his tendency to develop ulcers could not be found.

Usually all symptoms are completely relieved following gastro-enterostomy for from 6 months to 1 year (Eusterman); then there is a gradual return of all of the evidences of ulcer. Often the manifestations are not quite so severe as they were originally; the pain is usually described as lower in the abdomen and more to the left, without periodicity, and the relief of pain by food and alkalies is not so complete. Although hæmorrhage from the stomach or bowel is not common with the secondary ulcer, when it does occur it is suggestive of ulcer, especially if there has been no bleeding before the first operation.

I know of only one case of perforation of a jejunal ulcer into the abdominal cavity. A gastrojejunostomy had been performed on this patient 4 years previously and he was completely relieved for some time. Four years later he was operated on elsewhere for an acute perforation of a jejunal ulcer. Wright reports that he found records of 31 acute perforations in 135 cases and states

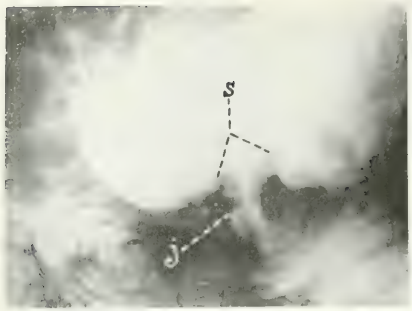



Fig. 5 (127252). S, Deformity of stoma; J, narrowing of the efferent loop of the jejunum in a case of jejunal ulcer.

that perforation is more common following anterior gastro-enterostomy than after posterior gastro-enterostomy.

I have been particularly interested in a group of cases in which the ulcer perforated into the colon, forming a gastrocolic or jejunocolic fistula. Bolton and Trotter state that a trifle more than 10 per cent of jejunal ulcers become adherent to the colon and perforate into it. They collected 31 such cases, including 4 of their own. If the ulcer is in the jejunum the colon may easily come into contact with it and as the ulceration extends it may perforate directly into the colon. However, in the 6 cases of colonic fistula in the series of 101 ulcers the perforation occurred more often when the ulcer was close to the mucosa of the stomach. In such cases the ulcer extends into the mesocolon so that it becomes involved in the ulceration and is greatly thickened and œdematous. This later contracts and pulls the colon down onto the anastomosis and a fistula follows. In performing the primary operation this may be prevented by suturing the edges of the opening of the mesocolon well back onto the surface of the stomach and making the opening as near as possible to the root of the mesocolon so as to keep the colon well away from the suture line. The first intimation the patient has of the existence of a fistula into the large intestine is a persistent diarrhœa, the vomiting of fæcal material, and belching of foul-smelling gas. If the fistula is large and especially if it is of the gastrocolic type, diarrhœa is produced almost immediately after food is taken into the stomach and the food is passed in much the same form that it was taken. Emaciation becomes marked very quickly. In one of our cases complete relief of all gastric symptoms was obtained by gastro-enterostomy and there was no suggestion of further trouble until 5 years later when the patient was seized with an attack of persistent diarrhœa. A roentgen-ray examination of the colon made a few minutes after a bismuth enema revealed a considerable portion of the bismuth in the stomach. In the other cases there was the usual history of jejunal ulcer for some time before evidence of a fistula into the colon. If the fistula is small and is between the jejunum and the colon it may produce diarrhœa and vomiting of fæcal material at intervals; at other times the food is passed normally and the fistula seems to be closed.

### DIAGNOSIS

Jejunal ulcer is always to be suspected when a recurrence of symptoms follows an interval of relief as a result of a gastro-enterostomy for ulcer. These symptoms may be the result of reactivation of the original ulcer but in most instances they are due to a secondary ulcer. The development of malignancy must also be considered as well as an inflammation in the appendix or in the gall-bladder. Roentgen-ray examination offers the most accurate method of differential diagnosis (Carman). A fistula into the colon may or may not be determined by the roentgen ray. In some of the cases in which a large fistulous opening was found at operation the opening had not been demonstrated by the roentgen ray but a jejunal ulcer had been demonstrated.

### TREATMENT

The possibilities of prophylaxis, I believe, have not been considered sufficiently in the treatment of jejunal ulcer. We must recognize the fact that it is not enough to perform a gastro-enterostomy and dismiss the patient without further treatment. Fewer

Fig. 6. (160721.) Duodenal ulcer. *u* indicates the deformity due to ulcer.

Fig. 7. (160721.) *s* indicates the deformity of the stoma due to jejunal ulcer seven weeks after operation for duodenal ulcer shown in Figure 6.

secondary ulcers will occur if other foci of infection within the abdomen are eliminated together with the more commonly recognized areas for focal infection. Reducing trauma to the tissues and dispensing with the use of nonabsorbable suture material will tend to reduce the number of these cases. No doubt we have all paid too little attention to the after-care, especially the diet. Cases are reported in which a secondary ulcer followed very soon after a gross indiscretion in diet. Much can probably be accomplished if the patient is restricted and kept under a certain régime for a certain time.

If jejunal ulcer is diagnosed and the symptoms are mild it is well to try medical management with the hope of obtaining relief, although in the clinic usually we are not able to relieve these patients except by operation. Our experience leads us to believe that the best plan to follow at operation is to undo the gastro-enterostomy, excise the jejunal ulcer, close the opening in the stomach and intestine, excise the original ulcer, and at the same time perform a plastic operation on the pylorus if it seems best. In some instances it is necessary to re-establish the gastro-enterostomy or make a new one, but if possible, this should be avoided because more ulcers form in spite of all precaution.

In case a fistula has formed between the stomach and the colon or between the small intestine and the colon, the operation is liable to be tedious and difficult. A number of cases are reported in which it was necessary to excise a part of the jejunum, colon, and stomach, which makes a very formidable procedure. A large tumor is generally present at the site of the anastomosis but it is made up of greatly thickened and œdematous tissue. When a cleavage line is started in these tissues, often the old anastomosis can be exposed, the colon separated, and the opening in it closed. The stomach and the jejunum may then be separated and these openings closed. This is much simpler than resection and should be done when possible. This plan was carried out in 4 of the 6 cases of fistula. In one, a partial resection was required, and in one a complete resection. In one of the cases a gastroduodenostomy was made after the jejunal ulcer was excised.

## RESULTS OF TREATMENT

The results of the operations in these cases of secondary ulcer have been reasonably satisfactory, especially since the importance of dispensing, whenever possible, with the gastro-enterostomy has been realized. If a secondary ulcer has once formed after gastro-enterostomy it is surprising how many will continue to form if the anastomosis is main-

tained in these patients who seem to have some definite irregularity or specific infection. In a few instances I have observed such repeated occurrence in spite of the fact that alkalization and systematic postoperative management were established and kept up from the time of the operation. Ballance mentions two cases in which alkalies did not prevent the occurrence. Nevertheless, I believe that proper management during the healing of the tissues following gastro-enterostomy and for some time afterward offers a great deal in the prevention of secondary ulcers.

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# CLINICAL USES OF SALT SOLUTION IN CONDITIONS OF INCREASED INTRACRANIAL TENSION

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It has been shown experimentally that the pressure of the cerebrospinal fluid and the bulk of the brain can be reduced by the intravenous injection of a hypertonic solution. The occurrence of these changes was first demonstrated by Weed and McKibben (1, 2) in experiments on cats. It must have occurred to many that these experimentally produced changes might have a clinical value if capable of production in the human subject without untoward effects.

The purpose of the present paper is to describe these physiological responses as seen in the human subject. Certain factors which influence the changes have been brought out and will be detailed in their relation to the physiology and clinical application of the procedure. The method has been employed in a number of cases exhibiting increased degrees of intracranial tension. From these cases impressions have been gained as to certain details of the physiological mechanism involved and pathological conditions affecting its usefulness.

The first report of the clinical use of this principle was by Haden (3). In cases of cerebrospinal meningitis in which pressure symptoms developed (presumably due to blocking of the pathways of escape for cerebrospinal fluid) symptomatic improvement followed the intravenous injection of 40 per cent glucose solution. No more objective proof of the action of the solution was offered. With Dr. Cushing the present author (4) made a preliminary report of the objective demonstration of these changes in the human subject. Following this, Sachs (5) reported its use in two surgical cases showing increased intracranial tension and believed the procedure could be employed with usefulness.

The observations on patients recorded here were conducted coincidentally with an extension of the experimental phase of the subject. In these experiments (6) the effect of gastro-intestinal doses of salt solution, or salt ingestion[1] were investigated, for it was feared that the medullary depressant effects of intravenous doses might preclude their clinical use. Subsequently this fear has been shown to be not entirely warranted.

[1] Salt ingestion as distinguishable from the intravenous injection in the experiments of Weed and McKibben.

The experiments demonstrated, however, that gastro-intestinal doses of salt work the same reduction in cerebrospinal fluid pressure and brain bulk as intravenous doses. The changes are not accompanied by medullary depressant effects.

PHYSIOLOGICAL

Conditions approaching very closely the laboratory experiments were obtained by recording the cerebrospinal fluid pressure changes in a manometer connected to a lumbar puncture needle. Observations were made following both salt ingestion and intravenous injection. A manometer was employed of large enough bore to prevent great oscillations due to respiration or slight movements. These temporary pressure changes were further minimized by the use of a long needle of small caliber. The manometer was filled with normal (physiological) saline to 250 millimeters. The connection to the lumbar puncture needle was promptly established and without an appreciable loss of fluid from the canal. The curve obtained from such an observation is roughly the curve of mean pressure of the cerebrospinal fluid. After establishing the manometer connection the patient was given either sodium chloride in capsules by mouth or an intravenous injection of 15 per cent sodium chloride solution.[1] One of the curves is shown in Figure 1. It is self-explanatory. In other cases it has been found that if the column of fluid in the manometer is raised to a high pressure by the addition of fluid, absorption promptly takes place to an extent sufficient to re-establish the pressure existing before the manometer was raised. This obtains even when a low pressure has been established by salt injection.

While these observations demonstrated the same changes in pressure as occur in experiments, they gave no indication of the effects on brain bulk. In the laboratory experiments such observations were carried out by watching the protrusion or recession of the animal brain through a trephine opening in the skull. Opportunity for similar

[1] Lumbar puncture was done in these cases for the purpose of intraspinous treatment of lues in connection with which the salt solutions have been employed—observations to be reported later.

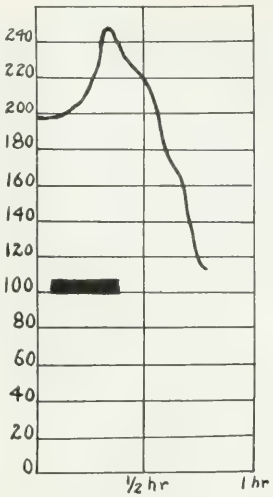


Fig. 1. Curve of pressure (millimeters normal saline) recorded by a manometer connected to a lumbar puncture needle. At the point indicated the patient was given 190 cubic centimeters of 15 per cent sodium chloride solution intravenously.

observation was afforded by patients with protusions following decompression operations. In these cases the operation had been done for increased tension incident to presumed intracranial tumor growth. The underlying lesion doubtlessly conditioned the responses which for this reason cannot be considered as strictly physiological. It was noted that the change in bulk was much greater in the presence of an internal hydrocephalus than in the cases where the ventricles were not dilated. With these allowances the responses may be interpreted as physiological. They also offer an explanation of the discrepancies between the effects produced in some of the clinical cases described in a later section. The accompanying photographs illustrate the changes in the two types of case.

The patient in Figure 2 had a large glioma of the right temporal lobe disclosed during a decompression operation. Subsequently an enormous, tense protrusion developed at the decompression site. The photograph,

Figure 2, illustrates the condition before salt was given. Immediately after making the photograph the patient was given 100 cubic centimeters of 30 per cent sodium chloride solution by mouth. There was a gradual decrease in the tenseness of the protrusion which became obviously softer and somewhat smaller. The circumference of the head above the brows decreased from 60 centimeters to 59 centimeters. The photograph Figure 3 was made two hours after taking the salt solution. The protrusion had become very much softer and as may be seen there was a very appreciable decrease in its size.

The patient in Figure 4 presumably had a tumor. It was never disclosed. At the decompression operation a marked internal hydrocephalus was found, a large amount of fluid being obtained by puncture of the right lateral ventricle. There was considerable collapse of the brain following this. As is common in cases of hydrocephalus, the protrusion which subsequently developed at the decompression site was extremely tense. Figure 4 shows the condition before the administration of salt. The other photographs (5 to 7,b) were made at approximately one hour intervals following the taking by mouth of 80 cubic centimeters of 30 per cent sodium chloride solution. The changes here were extensive. At the end of 3 hours the tense protrusion had become a soft concave area about which the margins of the bone defect were clearly outlined.

The observations which these photographs illustrate deal primarily with changes in brain bulk though in the second case the volume change observed must have been due largely to an absorption of fluid from within the ventricle. (*Vide infra.*)

An attempt was made to study the volume changes in such cases in relation to the coincident pressure changes. To this end an apparatus was arranged which we have called a "balloon-cast-manometer system." It is shown in Figure 8. A plaster-of-Paris cast of the protrusion with the surrounding area was made. Into the hollow of this cast, made by the protrusion, a toy balloon was fixed with its stem extending through a hole to the outside of the cast. The cast was applied to the hernia with the balloon lying between. The stem of the balloon was connected by tubing to a manometer and the system filled with water. Such an apparatus is similar in principle to the ordinary clinical sphygmomanometer used in blood pressure determinations. By means of a stop cock and side connection to a fluid reservoir it was possible to alter at will the volume of fluid contained in the system. After filling the system at medium pressure (150 millimeters $H_2O$) and then raising the manometer column to a high pressure it was found that the column would come to rest at a constant level of approximately 250 millimeters. This equilibrium at a constant level is apparently established by the absorption of fluid at the artificially increased pressure.

With this apparatus observations were made of the pressure and volume changes in a decompression protrusion in a patient who had an intracranial tumor. Needle exploration at operation had failed to disclose a dilated ventricle. The observations were made 2 months following the decompression operation. A tense cerebral protrusion had developed. By preliminary test the column of fluid was found to come to rest at 230 to 240 millimeters $H_2O$. Sixteen grams of sodium chloride were now given in 2 gram capsules accompanied by 80 cubic centimeters of water. The fall of pressure which this produced is shown by the curve Figure 9. The coincident decrease in brain-cerebrospinal fluid volume as determined by the fluid displaced out of the manometer with falling pressure is represented by the same curve. The figures to the left indicate pressure change in millimeters $H_2O$, those to the right volume change in cubic centimeters. Thus the fall of pressure from 240 millimeters to 80 millimeters was accompanied by a decrease of brain-cerebrospinal fluid volume of 3.2 cubic centimeters. The fall of pressure was rapid. At the end of the observation fluid was allowed to run from the reservoir into the system under the same pressure as existed before salt was given—240 millimeters. Under this artificially increased pressure further decrease in volume to the extent of 17.4 cubic centi-

meters took place. After the cast was taken off and this high external pressure removed, the protrusion was observed for several hours. It remained soft but without further diminution in volume. No such change in bulk occurred as was observed in the internal hydrocephalus patient shown in the photographs Figures 4 to 7b.

Thus it is seen that salt solution will produce a rapid and extensive fall of pressure but under the lowered pressure so produced and in the absence of a dilated ventricle the volume change is not great. If the original pressure now be artificially maintained further decrease in volume occurs, but to a relatively small extent, 17.4 cubic centimeters.

A similar observation was conducted in the case of the patient with the dilated ventricle shown in Figures 4 to 7b. The pressure and volume change following 90 cubic centimeters of 30 per cent sodium chloride solution is shown in Figure 10. In time relation to the taking of salt solution the curve represents the same period covered by Figures 4 and 5. The fall of pressure was at a slower rate but just as extensive as in the previous case. For the period covered by the curve the volume change was only 3 cubic centimeters. But now when the protrusion was subjected to the pressure which had existed before salt was given (220 millimeters) it underwent a further marked decrease in volume of more than 50 cubic centimeters. After the cast had been removed the volume continued to diminish somewhat even in the absence of the artificially increased pressure.

Thus it is seen that in the presence of a dilated ventricle salt solution produces the same extensive fall of pressure but at a slower rate than when this condition is absent. But the eventual volume change is much greater in the case of the dilated ventricle and will occur spontaneously without artificially raising the pressure under which the fluid is absorbed.[1]

[1] So far as we are aware these changes observed in the human subject are the first observations of the sort recorded. In the preliminary report, to which reference is made in the text (4), the whole detail of the observations including a description of the apparatus, for the sake of brevity, was not set forth. Since then Ebaugh and Stevenson (Johns Hopkins Hospital Bulletin, vol. xxxi, p. 440) have described a somewhat similar apparatus in which an inverted tambour was applied to the protrusion. Readings were taken and the values interpreted in terms of intracranial pressure in accordance with the calibration of this apparatus. We believe that for study of the changes in the human subject our method is the more accurate.

Fig. 2 (at left). Patient with large glioma of right hemisphere. A very large, rather tense protrusion. Condition before salt ingestion.

Fig. 3. Same patient 2 hours following 100 cubic centimeters of 30 per cent sodium chloride solution by mouth. The protrusion has become rather soft. Note the appreciable diminution in size.

## DISCUSSION

The observations which have been presented are to be explained in terms of alterations in the fluid production and absorption mechanism. The same changes found in animal experiment occur in the human subject. The details of the process appear to be the same in the two.

The increased osmotic value of the blood occasioned by the solutions introduced into the body promotes the absorption of fluid from the cerebrospinal spaces at an increased rate. This absorption of fluid will continue even under the lowered mechanical pressure which results. On the other hand, the rate of fluid formation by the choroid plexus is diminished or arrested. Even in the presence of the lowered mechanical pressure fluid is not elaborated. The effect of these changes is a marked lowering of intracranial fluid pressure.

Ebaugh and Stevenson studied intracranial pressure relationships in an epileptic and found the attacks to be preceded by and associated with increased tension. An interesting corroboration of this is found in one of our first cases studied. The patient had an intracranial tumor and was subject to Jacksonian attacks. There were definite aurae. During the process of making a lumbar puncture observation there were two sudden rises of pressure of 100 millimeters. Each time this pressure rise occurred the patient said "I feel a spell coming." No seizure actually occurred.

Fig. 4 (at left). Patient with dilated ventricle. An extremely tense protrusion. Condition before salt ingestion.
Fig. 5. Same patient 1 hour following 80 cubic centimeters of 30 per cent sodium chloride solution by mouth. The protrusion has become very soft. Note the appreciable diminution in size.

The mechanism by which increased intracranial tension is produced is a problem which in spite of much study remains without solution. The observations recorded in the previous section render very little toward a proved solution of the problem but together with the extensive clinical use of salt solution in conditions of increased tension they have led to speculation concerning the mechanism by which the condition is produced. Though lacking in absolute proof it may be of interest to express these speculative views since they offer an explanation of the phenomenon as it occurs under different pathological alterations and as affected by salt solution.

It is possible that with tumor growth or ventricular obstruction the brain at certain points is pressed securely against the dura closing off a number of the pathways of fluid escape through the arachnoid villi and along the sheaths of the cranial nerves. This narrowing of the absorption bed now causes the fluid to be held under increased tension. Were the absorption mechanism reduced to zero by closure of all these pathways the fluid tension should finally be equal to the maximal pressure against which the choroid will produce fluid.

If the disturbance is occasioned by solid tumor growth, with its surrounding area of brain œdema, the enlarged brain substance may itself, crowded into the rigid cranium, be under increased tension by its contact with the cranium, and quite independently of the fluid tension in the cerebrospinal spaces. Under such circumstances the subarachnoid fluid spaces would be encroached upon to the extent that the brain could be molded into the many fluid-containing crevices. The volume of fluid contained within the cranium would be small. Following salt ingestion the absorption of fluid from the remaining crevices reduces fluid pressure though the pressure of the brain substance against the cranium may not be relieved. Relief of the latter condition can only be accomplished by absorption of fluid from the brain substance itself (dehydration). If the tumor growth be large, relief by this means need not be complete. With an open skull (decompression) the volume change of the intracranial contents following salt solution would not be great.

These conceptions have been supported by our observations. The photographs (Figs. 2 and 3) of the patient with a solid tumor unaccompanied by ventricular dilatation show a trifling volume change. In another patient the measured volume change even under added external pressure was only 17.2 cubic centimeters.

If the disturbance is occasioned by a tumor causing ventricular obstruction and dilatation the pressure of the brain against the dura may interfere with fluid absorption from the subarachnoid spaces in the same way. If the fluid contained in the obstructed ventricle could not be absorbed the effect of salt ingestion here should be the same as in the former case where there was no dilatation of the ventricles. Such has not been the case. The observed changes under these conditions showed an extensive volume change (Figs. 4 to 7,b) while the measured volume change was more than 50 cubic centimeters though accompanied by a pressure decrease similar to that seen in a case of solid tumor without internal hydrocephalus.

It has been shown experimentally (7) that following salt ingestion absorption does take place from within the ventricles. The current in the aqueduct and ventricular system is reversed, fluid now passing from subarachnoid spaces to the ventricles. Here a reabsorption through the choroid plexus has been

Fig. 6a. Front view same patient 2 hours and 10 minutes following salt ingestion.
Fig. 6b. Same. Side view.

Fig. 7a. Same patient 2 hours and 55 minutes following salt ingestion.
Fig. 7b. Same. Side view.

demonstrated. This alteration in the absorption mechanism appears to take place in the human subject. In cases of internal hydrocephalus the great volume change of the cranial contents following salt ingestion is to be explained on this basis.

### CLINICAL USES

Clinically there are a number of conditions in which increased intracranial tension may develop. When present in appreciable degree it gives rise to the well known pressure phenomena—headache, projectile vomiting, slow pulse, and choked discs; with more extreme grades Cheyne-Stokes respirations, somnolence and unconsciousness ensue. The headache may be extreme and in general is the most troublesome subjective symptom. The more extreme grade of tension may become a condition of vital importance and determine the outcome in a given case. Marked tension offers a serious difficulty in intracranial operations. A brain of large bulk under great tension may make an operative procedure impossible. In such a case drainage of the cerebrospinal spaces is of no avail for the difficulty lies in the overcrowding of the brain substance itself.

In hydrocephalus ventricular puncture may be attended by excellent results, the pressure symptoms clearing up at once. Tension developing in a case of meningitis may be relieved by spinal drainage. Spinal drainage is not applicable in cases of intracranial tumor because of the danger of herniation of the brain stem through the foramen magnum. In the majority of these cases there has been no adequate means of dealing with tension short of a decompression operation or ventricular puncture.

From our experiences so far we believe that hypertonic salt solution intravenously or the gastro-intestinal ingestion of salt can be employed with some degree of success in a selected group of cases. The results to be expected in a given case are determined by the details of the pathology giving rise to the condition. The principles underlying these pathological alterations have been detailed in an earlier section.

The following brief abstracts of some illustrative cases indicate something of our experiences with the clinical employment of the procedure. In the first five cases there was tumor without dilatation of the ventricles. In the last four cases there was a ventricular hydrops associated with the tumor. There is a striking difference in the results as between the two classes.

Case 1. S. C., age 49, had a malignant adenoma of the pituitary. Two transphenoidal operations were done during the past 4 years. Each time a part of the tumor was removed. Three months ago the severe frontal headaches recurred associated with increasing drowsiness, apathy, and impairment of mentality.

During one of the severe headaches, which actually were almost continuous, 50 cubic centimeters of 15 per cent sodium chloride was given intravenously. There was very slight if any improvement.[1]

Case 2. A. A., age 41, had a large suprasellar growth. There were well marked pressure phenomena.

At operation an extremely tense brain was disclosed. Puncture of the ventricle failed to reach fluid. An attempt was made to relieve the pressure by salt solution. One hundred cubic centimeters of 15 per cent sodium chloride was given intravenously over a period of 22 minutes. There was a sufficient decrease of tension to permit of sufficient elevation of the frontal lobe to expose the pituitary region.

Case 3. M. M., age 18, had severe frontal and occipital headache. The detailed neurological examination indicated a left cerebral lesion. The pressure phenomena were well marked. There were bilateral choked discs. A left subtemporal decompression was done. A dilated ventricle was not disclosed by puncture. A tense protrusion developed at the decompression site.

Three weeks following operation signs of marked tension developed. She was drowsy and in poor condition. Fifteen grams of sodium chloride were given in capsules by mouth accompanied by a little water. An hour later the protrusion had become soft and lumbar puncture was done. The fluid was found under apparently normal tension. Following this the condition seemed somewhat improved.

Two days later the condition again became very poor. The patient would not respond. The decompression was extremely tense. Cheyne-Stokes respirations developed. Eighty cubic centimeters of 30 per cent sodium chloride solution were given by nasal tube. Within 10 minutes the Cheyne-Stokes respiration stopped, the patient opened her eyes and looked about. This period of relief was brief. Death occurred the following day. The autopsy showed a huge glioma of the left hemisphere.

Case 4. M. W., age 34, had headaches for 2 years, severe for the past 5 months with projectile vomiting; bilateral choked discs with marked impairment of vision. The other details of the neurological examination indicated a right cerebral lesion.

August 23 there was a particularly severe headache. The patient was somnolent and unco-operative. She was given 50 cubic centimeters of 15 per cent sodium chloride solution. Within 5 minutes the headache was entirely gone for the first time in several weeks. Three hours later she was completely free of headache. Tests showed a distinct improvement in visual acuity following the injection.

Four days later a right subtemporal decompression was done. There was marked tension. Dilatation of the ventricle was not demonstrated by needle punctures. Four months later a right sided exploration was done. The exact location of the lesion was not disclosed.

Case 5. T. G., age 42, had very severe headaches and projectile vomiting. There were bilateral choked discs with marked secondary atrophy and near-blindness. The detailed neurological examination indicated a lesion of the left hemisphere.

A subtemporal decompression was done. Half an hour before operation he was given 16 grams of sodium chloride in capsules by mouth accompanied by a little water. The dura when exposed did not appear to be under increased tension. There was no protrusion of the cortex when the dura was incised. No dilatation of the ventricle was disclosed by puncture.

It was felt in view of the preoperative findings that a very tense brain would have been found at operation had not salt been given. Following operation the protrusion became very tense.

Case 6. J. C., age 12, had severe frontal headache accompanied by projectile vomiting. There was primary optic atrophy and destruction of the dorsum sellæ. A transfrontal pituitary operation disclosed a cyst in the pituitary region with an internal hydrocephalus. The cyst was evacuated.

Ten days later pressure signs reappeared which reached a climax in the afternoon. The pulse was slowed and he became much excited and irrational. The headache was extreme.

Eighty cubic centimeters of 15 per cent sodium chloride solution were given intravenously. Within 10 minutes the patient quieted down and said the headache was almost gone. He slept for 2 hours. When awakened he said the headache was very slight. The relief appeared to be permanent.

Case 7. W. W., age 17, had severe frontal headache for 6 months. There were attacks of suboccipital and posterior cervical pain. Bilateral choked discs were found and the detailed neurological examination indicated a cerebellar lesion.

At 2:00 p.m. on the day of admission he complained of pain in the back of neck and became rather somnolent. This passed off. At 7:00 p.m. the same sort of attack began again. Patient acted peculiarly, was unco-operative and obstinate. Sat motionless on side of bed with the neck flexed far forward and forehead held in hands, complaining of headache. Would not move for fear of pain. Would scarcely reply to questions and then with dysarthria.

Patient was moved back into bed and propped up on pillows. One hundred cubic centimeters of 15 per cent sodium chloride were given intravenously. Headache and pain in neck promptly subsided, apathy and stupor disappeared and the patient slid down in bed and lay on his back without distress. He talked freely of the immediate improvement and was grateful. The nystagmus which had been present before had now (20 minutes after salt injection) disappeared. The changes were well marked objectively as well as subjectively.

Fig. 8. To illustrate the apparatus used in recording measured volume change in relation to pressure change. *A*, The toy balloon contained in the cast, *B*, of the protrusion. The sketch also shows the cast applied to the protrusion. *C*, The water manometer connected to the balloon by tubing. *D*, Stop cock and side connection to the fluid reservoir, *E*. By closing the stop cock *F*, and opening *D* the manometer column could be raised or lowered to any desired point. By raising the reservoir with the stop cocks *D* and *F* open, it was possible to subject the protrusion to a constant pressure and at the same time measure the volume change by the amount of fluid which was displaced out of the reservoir.

Case 8. M. T., age 34, had signs of pulmonary tuberculosis. Severe fronto-occipital headaches for 5 months. There were bilateral choked discs with secondary optic atrophy. The detailed neurological examination indicated a cerebellar lesion, probably a tubercle.

Beginning at 8:00 a.m. patient began to have pain in the back of the neck. It grew steadily worse.

10:30—Intense headache.

11:00—6 grams aspirin.

11:30—No relief. Patient says headache is most severe she has ever had. Writhes about in bed crying out with pain.

12:00—16 grams sodium chloride in capsules by mouth accompanied by 80 cubic centimeters of water. Within 10 minutes slight improvement was noted.

12:30—Quiet. Headache almost entirely gone. Very grateful, says she has never had such prompt and complete relief from these headaches.

12:50—No headache. Vision distinctly clearer, no diplopia. Is able to read a postal card received in mail today. Patient usually has marked dimness of vision and diplopia which become worse during the severe headaches. Ordinarily she is unable to read her mail.

The freedom from headache continued. There was no recurrence of it the following day.

Subsequently a cerebellar exploration was performed. She had a cerebellar glioma (verified) with hydrocephalus.

Case 9. A. C., age 52, had an intracranial tumor which at first gave no localizing signs. A subtemporal decompression was done. A tense protrusion developed. At a later time a suboccipital exploration was done with the disclosure of a cyst in the left cerebellar hemisphere.

January 20 the protrusion was very tense. The patient complained of headache and fullness in the head. One hundred and twenty cubic centimeters of 15 per cent sodium chloride were given intravenously. There was definite relief—the headache ceased and the sense of fullness in the head disappeared. Figure 11 shows the condition before salt was given. The condition two hours later is shown in Figure 12.

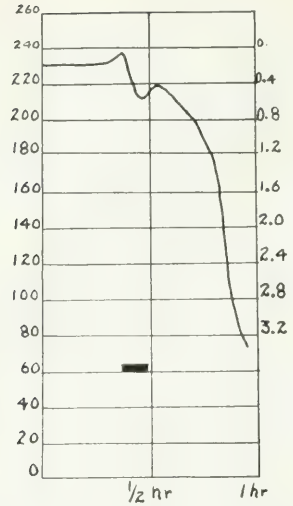


Fig. 9. Curve of pressure and coincident volume change obtained by the apparatus shown in Figure 8. The patient had a solid tumor. The figures to the left indicate pressure change in millimeters of water, those to the right the volume change in cubic centimeters. At the point indicated the patient was given 16 grams of sodium chloride in capsules by mouth.

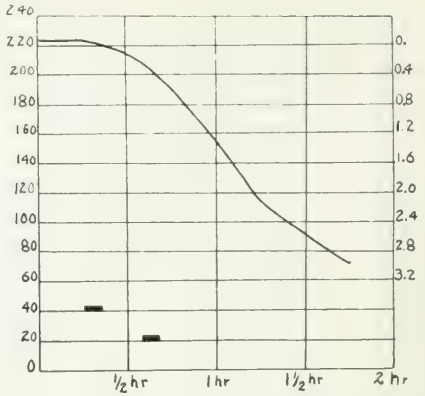


Fig. 10. Curve of pressure and coincident volume change. The figures to the left indicate pressure change in millimeters of water, those to the right volume change in cubic centimeters. The patient was given 50 cubic centimeters and 40 cubic centimeters of 30 per cent sodium chloride solution by mouth at the points indicated.

As stated, in the first five patients the increased tension was not associated with ventricular dilatation. In these patients the injection of salt solution was not attended by striking results.

In Case 1 a large solid tumor at the base was known to exist. No objective change was produced and symptomatic improvement was trifling or absent following salt injection. In Case 2 there was also a large basal tumor. The salt solution may have been of considerable value in effecting the exposure at operation but this is a difficult thing to estimate. In the third case there was a large, solid tumor of the hemisphere and the tension was not accompanied by a dilated ventricle. Salt solution produced a fall of fluid pressure as shown by the normal tension found on lumbar puncture. Sustained improvement in the extreme pressure symptoms could not be produced. Whatever dehydration of brain substance occurred was not sufficient to relieve the overcrowding of the cranial chamber. In the fourth case, presumably one of solid tumor, but at least not accompanied by internal hydrocephalus, the improvement following salt was perfectly definite. Here there must have been sufficient fluid to be drawn upon, or the tumor if present was of such small size that the dehydration of brain substance was effective in lowering pressure. In the fifth case operation following salt ingestion disclosed a brain under practically normal tension. Clinical manifestations of pressure indicated that without salt a tense bulging brain would have been encountered. The lesion here must have been of such size or so located that even in the absence of a dilated ventricle there was sufficient fluid absorption to produce a diminution in brain bulk and pressure.

In the last four cases a dilated ventricle was present. Here a large volume of fluid was contained within the cranium. Although held within the ventricular system, it apparently was available for absorption. Striking objective change and marked symptomatic improvement attended the use of salt in all these cases.

DISCUSSION

This procedure has a definite clinical usefulness. The results to be expected in a given case are determined largely by the pathological conditions giving rise to the increased tension. A distinction should be made between fluid tension *per se* and increased tension resulting from enlargement of brain bulk. In the former obstruction to fluid absorption is primary and is the essential feature. It is best illustrated by cases of internal hydrocephalus resulting from obstruction of the iter. In the latter an increased brain bulk is primary and is the essential feature. In both cases the pressure of the brain against the skull diminishes the volume of the subarachnoid spaces and obstruction to fluid absorption through the arachnoid villi probably ensues. From the standpoint of promoting fluid absorption from these obliterated spaces little is to be expected from the use of salt solutions. The presence of a large amount of intraventricular fluid in the hydrocephalus cases makes them amenable to relief by this means, for the fluid can be absorbed from within the ventricles. In the cases of increased tension resulting from enlarged brain bulk it would appear that relief can be secured only when the fluid spaces are not completely obliterated and contain an appreciable amount of fluid or at least when the limited absorption here is combined with an appreciable dehydration of brain substance. In the cases of very extensive tumor growth, "dry" brains with flattened convolutions and obliterated fluid spaces, the perivasculars and other fluid containing spaces of the brain substance are probably collapsed and little should be expected from dehydration.

Increased pressure associated with inflammatory processes in the meninges may represent a third type of fluid tension. Here the obstruction is near the arachnoid villi and is due to the inflammatory reaction about these structures. Weed (8) was able to cause such obstruction experimentally by injecting carbon granules into the subarachnoid spaces. Such cases appear to be another example of fluid tension *per se*. In cases of meningitis brain œdema doubtless enters into the mechanism, and possibly contributes to increased tension by obstruction to fluid absorption through the arachnoid villi by means of the pressure of the brain against the dura just as in tumor or in hydrocephalus. We have had no opportunity to study such cases but conceivably salt solutions would be effective for even though the fluid spaces should be nearly obliterated dehydration of an œdematous brain probably would be extensive.

Fig. 11 (at left). Patient in Case 9 before administration of salt solution.

Fig. 12. Same patient 2 hours following the intravenous injection of 120 cubic centimeters of 15 per cent sodium chloride solution.

The procedure has been employed in many cases in addition to those presented. In a general way they have borne out the above interpretation of the parts played by different pathological arrangements. Practically the administration of large doses of salt has been the most valuable therapeutic agent so far used in the treatment of "pressure headaches." Their action in the cases of headache associated with internal hydrocephalus has been very striking. Where the headache is unassociated with this condition some degree of relief usually is to be expected. Where it is desirable to make a lumbar puncture for diagnostic purposes in cases with increased tension the dangers of the procedure can be obviated in certain of the cases by first reducing the pressure by giving a hypertonic solution. The difficulties in anæsthesia so often met with in cases exhibiting marked degrees of tension can in part be overcome. This has been observed particularly in cere-

bellar operations. The procedure probably has some value in diminishing tension and aiding exposure at operation. By this means the risks of opening a very tight dura might be avoided. Where a decompression protrusion exists the presence or absence of an internal hydrocephalus can be demonstrated. If the ventricles are greatly dilated the protrusion will practically disappear following a large dose of salt, whereas if the protrusion is due to solid tumor growth the protrusion merely becomes softer and slightly smaller. This point may be of considerable diagnostic value. Possibly certain cases might be tided over periods of acute pressure though our experiences in such cases so far have not been striking.

We have reason to hope that the administration of salt, through relief of pressure, may permit more exact clinical observations to be made; as for example with the perimeter. In this way symptoms of a localizing value may be brought to light which under the conditions of increased tension could not be elicited. Increased visual acuity and widening of the visual fields have been observed.

SUMMARY

1. In the human subject intravenous injection of hypertonic salt solution or the ingestion of salt produces a fall of cerebrospinal fluid pressure and a diminution of brain bulk.

2. In conditions of pathologically increased tension the response is conditioned by the details of the pathological alterations. The determining factors appear to be the size of the lesion which increases brain bulk and the amount of fluid available for absorption. The induced fall of pressure is inversely proportionate to the former and directly proportionate to the latter.

3. A distinction is made between increased intracranial fluid tension *per se* and increased intracranial tension which is due to enlargement of brain bulk.

4. From observations of cases of obstructed and dilated ventricles an intraventricular absorption of fluid following salt ingestion seems to occur.

5. The procedure has a definite field of clinical usefulness in cases exhibiting high grades of intracranial pressure. The most striking results are to be obtained in those cases in which cerebrospinal fluid obstruction exists.

Acknowledgment is made of Dr. Cushing's stimulus in this study and my thanks are due him for the opportunity to carry out the observations on patients.

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# EARLY SQUAMOUS-CELL CARCINOMA OF THE CERVIX

## Accidentally Discovered When the Body of the Uterus was being Curetted for Hæmorrhage Caused by Hyperplasia of the Endometrium and by a Small Submucous Myoma[1]

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IN December, 1918, I saw a patient who had been suffering from very long and profuse periods. Examination of scrapings from the body of the uterus demonstrated that the excessive flow was due in part to a hyperplasia of the endometrium. To our surprise there was also a very early squamous-cell carcinoma of the cervix, too early to give clinical manifestations. Early cell changes are always interesting and this case, detected just after the carcinoma had started, is well worth describing in detail.

On April 26, 1915, I saw Miss H., age 46, in consultation with Dr. Lewellys F. Barker. The patient had commenced to menstruate at 14, had been irregular at the beginning and when the first period started she was having an attack of scarlet fever. The periods had been regular for 15 years, very free, lasting 5 days and sometimes 6 or 7 days. As a rule there had been no discharge between periods, but 5 years before I saw her she had noted a slight brownish or bloody discharge between periods for a time.

From the history we learned that in the summer of 1913 some small polypi were removed.

December 21, 1918. This patient came to see me a few days ago. For the last 15 months the periods have been increasing in frequency, have been irregular, and as a rule there has been an interval of from 2 to 10 days between them.

On examination I found the uterus nearly normal in size. There was a slight unevenness on the surface of the fundus. I curetted thoroughly and on examination of the scrapings (Gyn.-Path. No. 24,560), found definite gland hyperplasia (Fig 1). In one corner of the specimen was a small area of typical squamous-cell carcinoma. I was amazed beyond measure at finding the carcinoma and as there was only one small piece giving any evidence of malignancy I thought there might possibly have been some mistake. Fortunately this was the only curetting that we had during that week, consequently the chance of error was absolutely ruled out. We were not satisfied, however, and curetted again on December 28, 1918. The second scraping yielded a most beautiful example of early proliferation of the epithelium associated with the development of a squamous-cell carcinoma. In fact, it is the earliest case of squamous-cell carcinoma of the cervix that I have ever seen. The bleeding was undoubtedly due to the hyperplasia and to the small submucous myoma, and the finding of the carcinoma was one of those fortunate coincidences that will occasionally occur where the routine microscopical examination of scrapings is undertaken.

Operation, January 3, 1919. We did a complete Wertheim operation. It was rather difficult on account of the depth of the pelvis. The descending colon had grown fast to the broad ligament; this was loosened. We then opened up the left broad ligament, tied off the ovarian vessels, cut the bladder peritoneum and exposed the left ureter. The same thing was done on the right side. We cut the uterosacral ligaments on both sides early and got very good exposure. The uterus was removed without difficulty. Two drains were laid in the pelvis and brought out through the vagina. One was left in the abdominal wall down to the muscle. We

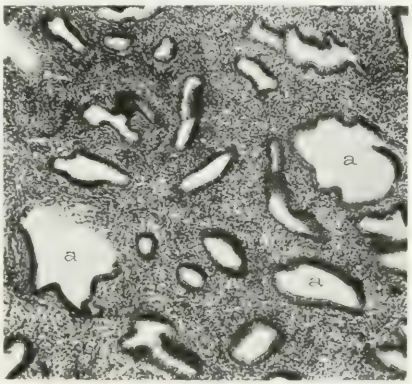


Fig. 1. Moderate hyperplasia of the endometrium. (Gyn.-Path. No. 24,560.) The mucosa in places looks perfectly normal. At other points, as indicated by *a*, the glands are much larger than normal. This increase in size is not due to any obstruction, as the glands are not spherical. The stroma in some places is rather dense. The picture is that of a moderate gland hyperplasia—a condition invariably accompanied by very profuse menstrual periods.

[1] Read before the meeting of the Texas State Section, Clinical Congress of American College of Surgeons, Dallas, January 8, 1921.

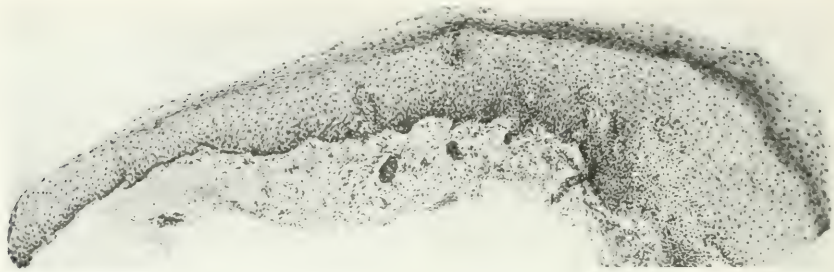

Fig. 2. Thickened squamous epithelium from the vaginal portion of the cervix. (Gyn.-Path. No. 24,560.) At the left of the picture the squamous epithelium is of normal thickness, but as we pass to the right it gradually increases in thickness and at the extreme right is fully three times as thick as normal. That this appearance is not due to the epithelium being cut on the bevel is definitely proved by the picture shown in Figure 3.

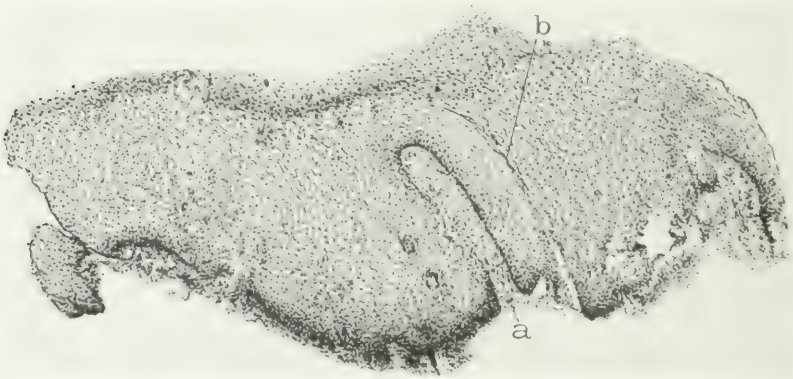


Fig. 3. Proliferation of the squamous epithelium in an early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) The epithelium is at least three times the normal thickness. At *a* is a papilla. This is fully twice as long as usual and is evidently pushing outward, as is clearly indicated by the sharp line of differentiation between its surrounding epithelium and that in the neighborhood. This is remarkably well shown at *b*. This picture clearly indicates how the finger-like processes so frequently noted on the surfaces of squamous cell carcinoma of the cervix develop.

removed the appendix which was tied down in its middle portion. The patient stood the operation well, but made a slow recovery on account of a marked thyroid condition.

On opening the uterus (Fig. 14), I found a submucous myoma 1.5 centimeters long. Near the internal os was a small papillary growth 9 millimeters long, 3 millimeters broad.

In 1900 I described two cases of hyperplasia of the endometrium.[1] At that time we had not given this definite pathological lesion a name. It was referred to in detail in my *Adenomyoma of the Uterus*[2] in 1908. Since then we have observed many cases and the subject has been fully considered by Dr. Emil Novak[3] and others.

Although hyperplasia may occur in girls in their teens it is usually noticed during the

[1]Thomas S. Cullen. Cancer of the Uterus, 1900, p. 470.

[2]Thomas S. Cullen. Adenomyoma of the Uterus, page 182.

[3]Emil Novak. Hyperplasia of the endometrium. Am. J. Obst., v. 63, lxxv, 2.

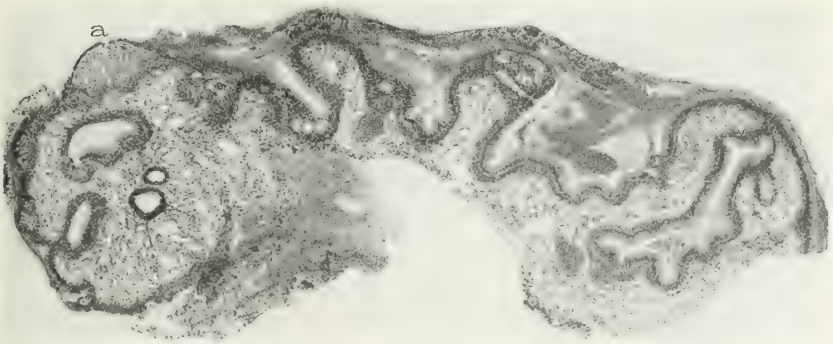


Fig. 4 Proliferation of the surface epithelium in a case of very early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) Nearly the entire tissue consists of normal cervical mucosa with its characteristic high cylindrical epithelium. At *a* is a proliferation of epithelial cells looking like squamous epithelium. From the location one would naturally infer that it was the cylindrical epithelium which had proliferated, but we all know that as a rule, where cylindrical epithelium proliferates, new glands are formed. From our histological studies we know that squamous epithelium at times extends far up into the cervical canal and in such cases the glands must of necessity open directly onto squamous epithelium. Whatever the explanation may be, we have in this picture a proliferation of epithelium with the formation of a solid mass of epithelial cells. For other views of this mass of epithelial cells, see Figures, 5 and 6 at *a*.

Fig 5. Localized proliferation of epithelium in a very early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) At *a* is the localized outgrowth of what appears to be squamous epithelium. See also Figures 4 and 6 at *a*.

childbearing period. The most prominent symptom is an excessive menstrual flow.

The very free flow in the case under discussion was due in part to the moderate degree of hyperplasia noted in Figure 1, in part to the submucous myoma (Fig. 14). There was no intermenstrual discharge, when she came under my care.

When we turn to the carcinoma of the cervix we find that the squamous epithelium which at some points is perfectly normal, gradually increases in amount until it is three

Fig. 6. Localized outgrowth of cervical surface epithelium in a case of early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) At *a* is a localized proliferation of epithelium resembling that of the squamous-cell type. See also Figures 4 and 5 at *a*.

Fig. 7. The formation of an epithelial pearl in a case of very early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) The squamous epithelium apart from its thickness is little altered. At *a* is a very young epithelial pearl. In the area *b* the epithelium is a little irregular and wavy. I have never seen an epithelial pearl in the squamous epithelium of the cervix except where cancer existed. Horny epithelium is now and then noted where prolapsus is present. In such cases the exposed cervix is naturally subjected to considerable irritation. Our patient was an unmarried woman. The cervix was in its normal position, and there was no evidence of any inflammatory reaction. Not a single polymorphonuclear leucocyte is to be seen in the field.

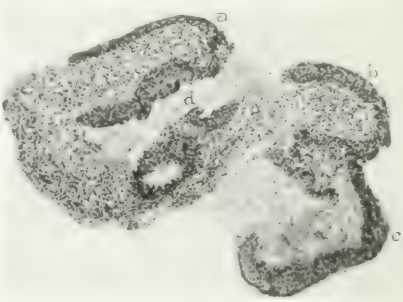


Fig. 10. Young finger-like processes in an early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) *a*, *b*, and *c* are early finger-like processes. Each is covered by several layers of deeply staining squamous epithelium. At *d* some of the epithelial nuclei are large, stain intensely, and at once indicate malignancy. For other finger-like processes see Figures 8 and 9.

or four times as thick as usual (Figs. 2 and 3). At other points the epithelial cells bear a rather confused relationship to one another; in other words, they present a rather jumbled-up appearance instead of preserving their usual orderly arrangement. (Fig. 7, *b*.) At one point we found a typical epithelial pearl (Fig. 7, *a*).

The cylindrical epithelium of the cervix presented the usual appearance, but at several points on the surface there were well defined aggregations of cells (Figs. 4, 5, and 6). These cells looked like masses of squamous epithelium. Their exact origin is rather difficult to explain but we know that in some cases the squamous epithelium extends up the cervical canal as far as the internal os. In such cases the cervical glands open

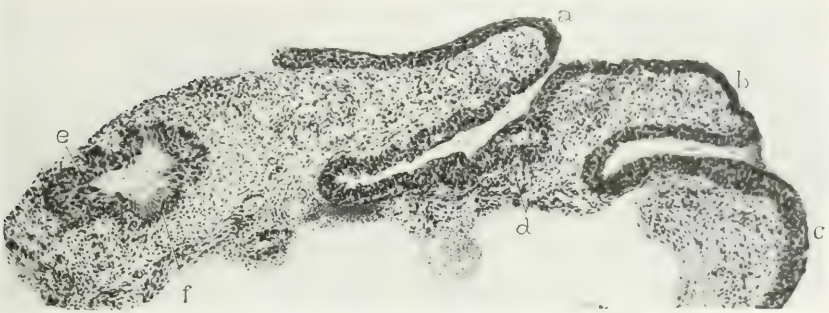


Fig. 8. Young finger-like processes in a very early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) *a*, *b*, and c are finger-like processes of stroma covered over by several layers of altered squamous epithelial cells. The epithelial cells are more closely packed together than normal, and their nuclei stain deeply instead of being vesicular. At *d* are a few vacuoles in the epithelial layer. At *e* the nuclei of some of the epithelial cells are larger than those of the surrounding ones. At *f* is what appears to be the normal cylindrical epithelium of the cervix. For other finger-like processes see Figures 9 and 10.

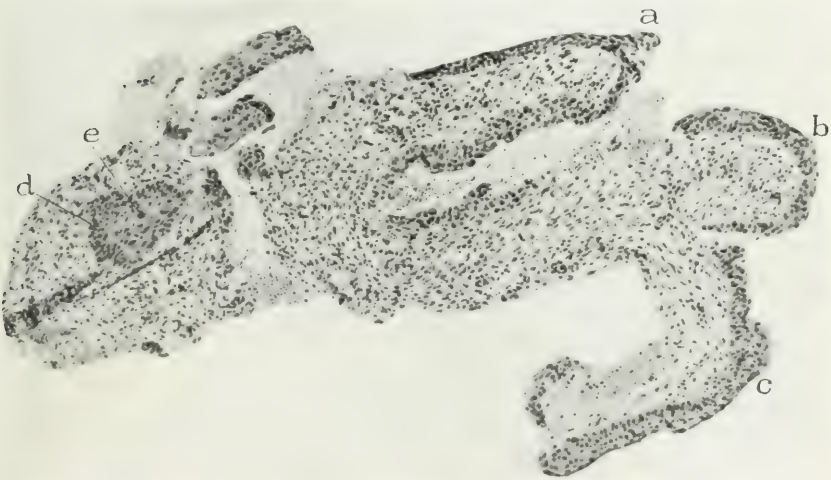


Fig. 9. Finger-like processes in an early squamous-cell carcinoma of the cervix. (Gyn.-Path. No.24,560.) *a*, *b*, and *c* are early finger-like processes covered over by altered squamous epithelium. At *d* is a cell nest and in the center of this is at least one large deeply staining nucleus, *e*. For other finger-like processes see Figures 8 and 10.

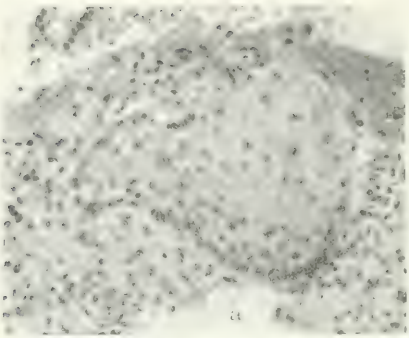


Fig. 11. A cell nest in a very early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) Some of the nuclei of the epithelial cells composing this nest are, as indicated by *a*, much larger than others and at once suggest the possibility of malignancy. For other nests see Figures 12 and 13.

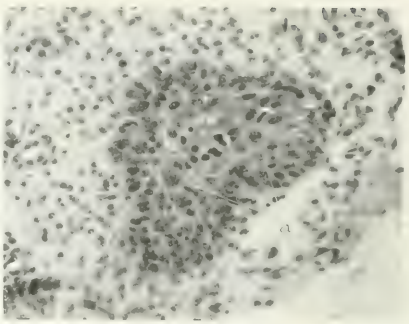


Fig. 12. A suspicious cell nest from a case of early squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) The cell nuclei stain darkly instead of being vesicular. Several of the nuclei are large and at once suggest malignancy. Those indicated by *a* are especially large. For other high power pictures see Figures 11 and 13.

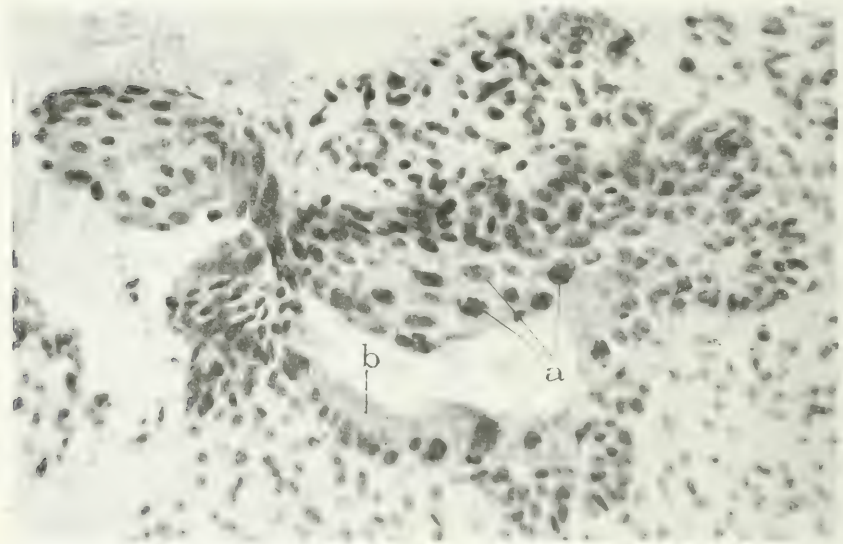


Fig. 13. Early cell changes in a squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) Many of the epithelial nuclei stain darkly. Those indicated by *a* are very large and suggest an active process. This picture is evidently taken just where squamous and cylindrical epithelium meet, as at *b* we find definite cylindrical cervical epithelium. For other cell changes see Figures 11 and 12.

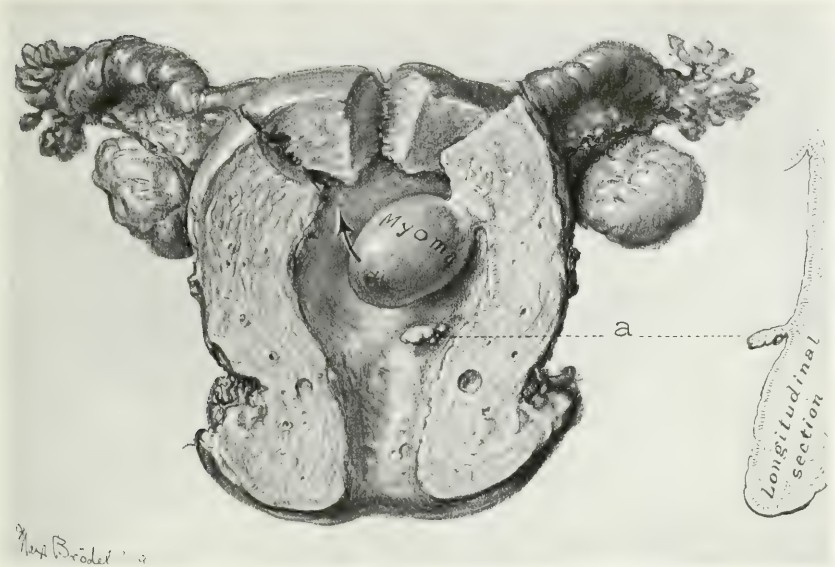


Fig. 14. Early squamous-cell carcinoma of the uterus. (Gyn.-Path. No. 24,587.) This is merely a rough sketch. The body of the uterus is a little larger than normal. Projecting into the cavity is a pedunculated submucous myoma. At *a* is all that remains of the small carcinoma that evidently started near the internal os. The length of the papillary process is indicated by the small sketch to the right. The remainder of the growth was brought away with the curette. The small myoma partially covered the papillary growth. It has been raised up as indicated by the arrow.

directly into a cavity lined with squamous epithelium.

From this case we learn much about the way in which the finger-like processes of squamous-cell carcinoma develop. The earliest stage is particularly well shown in Figure 3. Here a papilla has become fully twice as long as normal; that it is growing is clearly indicated by the line of demarcation *b*, between its surrounding epithelial cells and those of the adjoining epithelium. This finger-like process is already fairly well differentiated.

Most of the well-defined finger-like processes in this case are broad, have a well organized stroma and are covered over with squamous epithelium. This epithelium is several layers in thickness, stains very deeply and is markedly different from normal epithelium. Such finger-like processes are shown in Figures 8, 9, and 10.

Nests of altered epithelial cells are found scattered throughout the stroma in Figures 9, 11, and 12. With the low power, large, deeply staining epithelial nuclei are seen in Figure 8 at *e*, Figure 9 at *e*, and in Figure 10 at *d*. With the high power the variation in the sizes of the epithelial nuclei is well shown in Figures 11, 12, and 13.

The gross specimen is seen in Figure 14. In the cavity of the uterus is a small submucous myoma and the only remnant of the early squamous-cell carcinoma that evidently developed near the internal os is the small blunt papillary mass just above the internal os.

Some of the more skeptical might say that these findings, although suspicious, are not

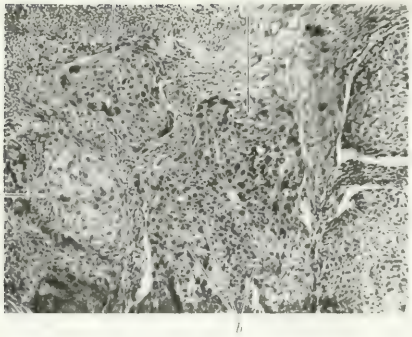


Fig. 15. Squamous-cell carcinoma of the cervix. (Gyn.-Path. No. 24,560.) The picture is that of a typical squamous-cell carcinoma of the cervix. Characteristic cell nests are to be seen at the points indicated by *a*. In some of the nests the cell nuclei are uniform in size, in others they vary much in diameter. At *b* are several large deeply staining nuclei. This is the cervical tissue that was brought away when the patient was being curetted for hyperplasia of the endometrium. The suspicious pictures noted in Figures 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, and 13 were obtained from cervical material removed at the second curettage.

conclusive of malignancy. My reply would be that we have never seen an epithelial pearl in the squamous epithelium of the cervix except in cases of squamous-cell carcinoma of this region, and further that we have never seen finger-like processes similar to those here shown except where squamous-cell carcinoma of the cervix existed. In this case, however, there is absolutely no room for doubt, as Figure 15 shows the most typical squamous-cell carcinoma that we could wish for. The arrangement of the cell nests and the individual cell changes are characteristic

From the location of the carcinoma near the internal os it is probable that it would have advanced far before being detected, had it not been for the fortunate coexistence of the hyperplasia and the small submucous myoma. Such early cases teach us more than dozens of late ones, where the early changes are lost or destroyed in the widespread growth. It is to the early diagnosis of carcinoma of the cervix that we must look for future success.

There is no evidence of a return of the carcinoma in this case, and we are confident that the patient will have no further trouble from it.

I cannot let the opportunity pass without expressing my sincere appreciation of the excellent photomicrographs furnished to us by Mr. Herman Schapiro.

# RARE TUMORS OF THE CERVIX OF THE UTERUS OF INFLAMMATORY ORIGIN—CONDYLOMA AND GRANULOMA[1]

By LAWRENCE R. WHARTON, M.D., Baltimore
Resident Gynecologist, The Johns Hopkins Hospital

## CONDYLOMA OF THE CERVIX

CONDYLOMA of the cervix is one of the rarest of gynecological disorders. The infrequency with which this condition occurs is indicated by the fact that in the past 30 years we have seen only three cases of this disease in the Johns Hopkins Hospital. The attention of the author was drawn to this subject by the fact that there recently came under his care a patient with this unusual condition and also by the fact that few of the visiting staff and none of the house men had ever seen a similar lesion before.

Its rarity is further reflected in that the literature for the past 20 years seems to contain no reports of any definite cases of gonorrhæl cervical condyloma and records less than a dozen cases of condyloma of all other types. In 1900 Cullen (2) reported in detail a case of condyloma of the cervix due to tuberculosis (Gyn. No. 6564) in connection with the differential diagnosis of carcinoma of the cervix. In 1907 Maley (3) gave a report of a similar case and was able to find only nine others of this type in the literature. He did not mention condyloma or papilloma of the cervix associated with gonorrhœa or any other condition. Kelly and Noble (4) state that condyloma acuminata may occur on the cervix but do not describe the lesion. They further state that tuberculosis of the cervix may assume the form of a "hyperplastic vegetative outgrowth which resembles a venereal wart or an early papillary carcinoma." Winter and Ruge (5) give an extremely brief discussion of acuminate condylomata in discussing the differential diagnosis of cervical tumors. Norris (6) states that cervical condylomata are extremely rare, are liable to occur during pregnancy,[1] may vary in shape, are often pedunculated and usually are secondary to gonorrhœal cervicitis. One would hardly expect, however, in textbooks which cover the whole field of gynecology to find lengthy treatises on lesions which are as unusual as this. It rather falls within the province of special articles to record these rarities, and for this reason, it has seemed to us worth while to report the cases which have come under our observation.

Condylomata are classed as typical lepidic growths, coming under the group of papillomata. Adami (7) describes them as "outgrowths from surfaces presenting a covering layer of epithelium, whether squamous or columnar, having a more or less pronounced connective-tissue core to each individual process." Such tumors are common on the external genitalia, the perineum, or around the rectum, particularly in association with gonorrhœa or syphilis. Patients with such lesions almost always give the history of having had a profuse and irritating vaginal discharge. Such tumors are altogether benign, and if seen early will usually clear up entirely if the source of the irritation is removed. Appearing at first as small, isolated papules or papillomata on the external genitalia or the perineum, they often attain large size, coalesce and eventually form a large cauliflower growth entirely covering the labia, surrounding the urethra, breaking down in places to form excavated ulcers,—in all forming an extremely repulsive and yet serious therapeutic problem. This type of lesion is so common that every gynecologist is acquainted with its characteristics.

The cervical type of condyloma is as rare as the vulval type is common. When compared in frequency with epithelioma of the cervix, it occurs in the ratio of less than one to three hundred, for, during the period in which we have observed three cases of cervical condyloma, we have treated in the hospital about seven hundred cases of carcin-

[1] Cullen tells me he saw a case in which there were three or four small condylomata on the posterior lip of the cervix, associated with early pregnancy.

[1]From the Department of Gynecology of the Johns Hopkins Hospital and University.

oma of the cervix and have observed many others too far advanced for any form of curative therapy. Because of its extreme rarity, it has drawn scant attention in the literature and we are, therefore, compelled to turn in the main to our own material for a description of the lesion.

*Etiology.* Of our three cases, two were gonorrhœal and one was tuberculous. In one case (Gyn. No. 9454) the lesion was of the classic textbook type, there being a single pedunculated condyloma situated on the posterior lip of the cervix, accompanied by a cauliflower-like mass of condylomata acuminata which covered the external genitalia and perineum. The second gonorrhœal case (Gyn. No. 25625) presented the characteristic history with the typical pelvic lesions of an old Neisser infection of long duration. The patient was a negress, 25 years old, who had been sterile since a pregnancy which had occurred at the age of 15. At the time of her admission to the hospital in January, 1920, she had a tubo-ovarian abscess, chronic salpingitis, encysted pelvic peritonitis and a massive granulomatous growth on the cervix. In our case of tuberculous condyloma, the diagnosis was established by the pathological examination of the tissue removed at operation. Syphilis seemed to play no part in these cases, as neither the history nor the clinical findings indicated the presence of this disease in any of these patients. Two of these patients were observed before the days of the Wassermann reaction; the third (Gyn. No. 25625) gave a negative result in the blood on two separate examinations. In one of our three cases, the condylomata developed very soon after a pregnancy. It has always been stated that gonorrhœal condylomata are particularly liable to be associated with or follow pregnancies. In our experience, then, it seems that gonorrhœa and tuberculosis are the etiological factors in the production of cervical condyloma.

*Pathology.* Condylomata are benign, inflammatory tumors, consisting of papillary growths of which the essential constituents are a connective-tissue core covered by the same type of epithelium which is present on the surface from which they spring. Both the connective tissue and the epithelial elements in condylomata may undergo secondary changes due to trauma, infection, or any such factors. Malignant transformations have never been observed by us. Cervical condylomata are covered either by squamous or cylindrical epithelium, depending upon the portion of the cervix from which they arise. There being no horny layer in normal cervical epithelium, one would not expect to find that layer present in cervical condylomata under ordinary conditions.

Because of the scarcity of material, it is impossible to generalize too broadly on the pathology. Furthermore, since each of our cases presented a different picture both in the gross and microscopic characteristics, we shall be compelled to consider each type individually. Of our two cases of gonorrhœal condyloma, one was a solitary pedunculated papilloma consisting of a core of loose fibrous tissue covered by normal intact squamous cervical epithelium. There was a very mild grade of chronic inflammatory reaction in the connective tissue of the growth. In the other instance, as is shown in the accompanying drawing (Fig. 1), almost the entire cervix was replaced by a cluster of blunt papillomata each about 4 to 6 millimeters in diameter and varying in height from 1 to 1.5 centimeters. These individual processes were rounded, purplish-red, not ulcerated, very soft, offering almost no resistance to the examining finger, lying closely crowded together over the vaginal portion of the cervix, forming a striking contrast with the narrow strip of white, squamous epithelium which covered the unaffected area on the posterior lip of the cervix. The cervical canal itself was not involved in these growths. These papillomata were extremely superficial, the firm tissue of the cervix being felt very clearly through the soft mass. The body of the cervix itself was quite normal except for a low grade inflammatory reaction and a rather marked hypertrophy.

When viewed under the microscope (Fig. 2), it is seen that these granulomatous tufts were entirely devoid of true epithelium. The squamous epithelium of the cervix came to a sharp and normal termination just at the

border of the inflammatory mass and there was no trace of any epithelium over the papillomata. They were covered, however, by a delicate layer of fibrin and coagulated exudate such as would be found in a true erosion of the cervix. The stroma of these tufts presented a most acute grade of inflammatory reaction and throughout it were scattered numerous cervical glands with their high cylindrical epithelium. In this case, as Novak suggests, it may be that these granulomatous tufts represented the late stage of a true cervical erosion with unusual inflammatory proliferation. Whatever may have been the mode of development of these growths, both in the gross and microscopic examination, they presented an extremely unusual and almost unique picture. As in Maley's case of tuberculous condyloma and in this case of gonorrhœal granuloma, the outgrowth probably had its origin in the area of the cervix that was covered by cylindrical epithelium, and as these masses grew the squamous epithelium of the cervix seemed to recede before their advance.

The character of the stroma of the gonorrhœal condylomata varies with the grade of inflammatory reaction present. In the typical picture there is a fibrous core which is continuous with the underlying connective tissue and which weaves its way up into the various condylomatous tufts. This was the type of stroma in one of our cases (Gyn. No. 9454). In this instance the inflammatory reaction was of a very low grade. In the other case (Gyn. No. 25625) there was a very acute inflammatory reaction. The granulomatous tufts consisted of almost nothing but acute inflammatory tissue, packed with leucocytes, markedly vascular, with almost no evidence of organization (Fig. 2). Throughout the inflammatory tissue underlying these papillomata were scattered normal cervical glands. There was also a marked endocervicitis. The severe grade of inflammatory reaction present is shown clearly in the accompanying drawing.

Tuberculous condyloma of the cervix has been studied especially by Kaufman and Maley. According to Kaufman, tuberculosis of the cervix may take three forms: miliary, ulcerative, or papillary. Maley states that the papillary or condylomatous type is by far the rarest of these. He was able to find only nine cases that had been reported in the literature before 1907. Fortunately, in reporting his own case, he made a careful pathological study, the records of which agree with ours in all important considerations.

Fig. 1. Condyloma of the cervix, gonorrhœal. Gyn. No. 25625. Gyn. Path. No. 25662. The raised, soft, papular growth on the hypertrophied cervix is clearly shown. There is a small cluster on the right vaginal margin where the growth has extended beyond the cervix. The small fibromata on the labium majus to the right of the urethra have no connection with the condyloma. At first glance one might call this cervical tumor a papillary carcinoma.

In the gross, tuberculous condyloma is usually accompanied by marked hypertrophy of the cervix. In Maley's case the virginal cervix was "as large as a small apple." In our case, the cervix and its papillomata filled the upper third of the vagina. The gross characteristics of such a tumor are rather unusual on palpation. One feels a large, soft, smoothly lobulated mass which seems to replace the cervix completely. It is not

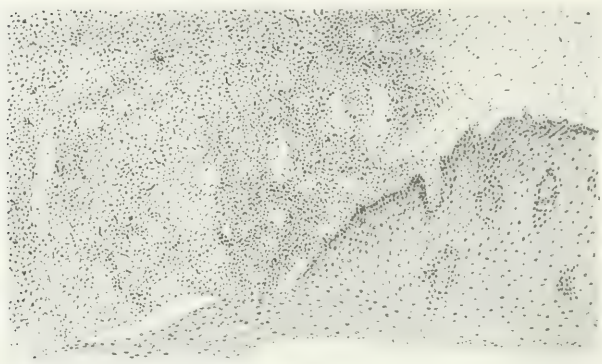

Fig. 2. Condyloma of the cervix, gonorrhœal. Gyn. No. 25625. Gyn. Path. No. 25662. This illustration gives the microscopic picture of a section of the tumor shown in Figure 1. The field shows the border of one of the condylomata. The normal squamous epithelium of the cervix is seen to disappear gradually, being undermined by the inflammatory mass which consists of dilated blood vessels, leucocytes of both mononuclear and polymorphonuclear types, and fibroblasts. The epithelium over the condyloma has disappeared. There are no glands in this field but in other condylomatous tufts immediately adjacent are numerous cervical glands which show no significant pathological alterations. It is a benign inflammatory tumor.

very tender, might bleed slightly on manipulation, but the superficial growth is not friable and does not break off or give way under pressure as does carcinoma. The base of the growth does not present the firmness which is characteristic of carcinoma. It feels more like a sarcoma,—in fact, this was the diagnosis which Maley made in his case.

When viewed with the speculum the cervix is obliterated by lobulated masses which "look like exuberent granulation tissue, filling a cavity left by an operation" (Fig. 3). Occasionally clear cysts (dilated cervical glands) can be seen in these masses. If one attempts to curette away this mass, he is immediately convinced that he is probably not dealing with carcinoma because the tissue will not break off, there is no necrotic surface, and the curette hangs in tags of tough granulations.

On microscopic examination in Maley's case, these lobulated masses were covered by intact cylindrical epithelium. The pathology of our case was studied carefully by Cullen, who reported it in detail in his book on *Cancer of the Uterus*. The polypi were covered by many layers of squamous epithelium which was normal except for a slight leucocytic infiltration. The ducts of the cervical glands coursed down through a mass of tuberculous granulation tissue which was about 1.5 centimeter in thickness. The glands were normal. The inflammatory reaction was sharply marked off at the base of the granuloma.

It usually surprises the operator to discover how superficial these tuberculous condylomata are. Maley expected to find a sarcoma and did a panhysterectomy only to discover that the cervical growth was but 1 centimeter in depth. In our case (Gyn. No. 6564) the operator thought it would be necessary to perform a vaginal panhysterectomy, but on closer inspection found that the entire growth could be removed by a low amputation of the cervix.

*Endometritis and condyloma.* Until recent years the term endometritis has been used

to cover a multitude of gynecological complaints without any reference to its exact significance. We are using the word here in its accurate and pathological sense, meaning a true inflammatory lesion of the endometrium. When given this definition, endometritis at once becomes a much less common clinical entity than it was formerly supposed to be. These cases of gonorrhœal condyloma and granuloma demonstrate how resistant the endometrium of the non-pregnant uterus is to gonorrhœal infection. Although this fact has been known for years, it has not yet been appreciated by the medical profession. One has but to read over the current literature, the questions asked in State Board examinations or engage in conversation with the average practitioner to be assured of the fact that endometritis is still supposed to be one of the commonest of gynecological diseases and that curettage of the uterus is and always has been the panacea for all pelvic diseases. In 1898, Cullen reported before the Medical and Chirugical Faculty of Maryland that, in the examination of the tissue removed in eighteen hundred consecutive gynecological operations in the Johns Hopkins Hospital, he had observed real endometritis only forty-nine times. This series included all the hysterectomies and curettages, irrespective of the operative indication. He was one of the first to draw attention to the loose use of the word endometritis. This observation was later reported in the *Maryland Medical Journal*. It is with pleasure that we read such articles as those by Curtis (1) and Bovée (8) who in the last few months have again presented evidence in support of the opinion that endometritis is not commonly found in connection with gonorrhœa and that curettage of the uterus should be performed only with the strictest asepsis and under the most clear-cut indication.

In the light of modern conceptions as to the method of progress of a gonorrhœal infection in the female pelvic organs, it is hard to conceive how conditions could be more ideally suited for the development of endometritis than in the presence of endocervicitis and condyloma of the cervix, especially when

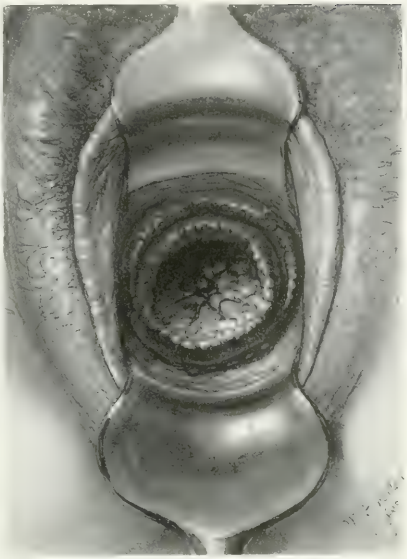

Fig. 3. Tuberculous condyloma of the cervix. Gyn. No. 6554. Gyn. Path. No. 2805. The illustration shows the lobulated, exuberant growth with the massive hypertrophy of the cervix. It has not invaded the vaginal mucosa, but has wholly replaced the superficial portion of the cervix. Both on palpation and visual examination, this tumor would be difficult to differentiate from carcinoma of the cervix.

these lesions are accompanied by bilateral pyosalpinx. In our two cases of gonorrhœal condyloma of the cervix, however, we found neither clinical nor pathological evidence of endometritis. In one instance the infection had caused gross lesions in the cervix, both fallopian tubes and ovaries, and yet the endometrium was unaffected. Although this patient had a bilateral tubo-ovarian abcess, chronic endocervicitis, and a massive and heavily infected condyloma of the cervix, the microscopic examination of the endometrium showed that it was normal. The offensive discharge was not in the least affected, moreover, by the supravaginal hysterectomy; it was not until the cervical growth was destroyed by the actual cautery that the leucorrhœa disappeared.

In tuberculous condyloma, the reverse seems to be the rule. In our case, the cervical lesion was accompanied by advanced tuberculous endometritis and also by a generalized dissemination of the infection involving both fallopian tubes, the spleen, kidneys, liver, intestines, retroperitoneal glands, lungs, pleura, and the brain. In Maley's case also, the endometrium was involved.

It seems, then, that the endometrium is not usually involved in connection with gonorrhœal condylomata of the cervix, even though there might be lesions in both fallopian tubes. In the case of tuberculous condyloma of the cervix, however, the cervical involvement is often merely the local manifestation of an infection, the lesions of which may be so generalized as to be at times systemic.

*Symptoms.* The most constant symptom referable to cervical condyloma is leucorrhœa. This was the chief complaint of all of our patients. The discharge is purulent, profuse, may have a bad odor, but has not the characteristic stench found in carcinoma of the cervix. At times the discharge may be blood-tinged, especially after coitus. In gonorrhœal condyloma, the symptoms due to salpingitis and its complications may be prominent, causing menstrual irregularities and abdominal pain. Similarly, in tuberculous condyloma, the history in a given case depends upon the extent of the associated lesions. In both types, the history may not be at all unlike that of early carcinoma of the cervix.

### DIAGNOSIS

Condyloma of the cervix must be differentiated from all conditions which would cause a profuse and bloody vaginal discharge, —carcinoma, cervical polypi with infection, sarcoma, benign inflammatory hypertrophy with deep lacerations, etc. The history might be of help in this regard but all patients who complain of a bloody vaginal discharge must be subjected to a rigid examination. On bimanual palpation, condylomata are not so firm, are not friable, do not bleed so profusely on manipulation, do not have the cartilaginous base and the easily broken down necrotic surface, and are not associated with the foul sickening discharge which characterizes advanced carcinoma of the cervix. It is with early carcinoma that they are more liable to be confused. On inspection tuberculous condylomata are smooth, lobulated, purplish-red, may present clear cystic areas due to enlarged cervical glands,—a picture not usually seen in carcinoma. In gonorrhœal condyloma the tufts may be of the granuloma type, consisting of small red papillomata, smooth, glistening, very soft and insensitive; or they may consist of isolated pedunculated acuminate growths resembling those which are found on the perineum, except that the cervical condylomata are pink or purplish-red, are soft and will usually bleed on manipulation.

As in the case of all cervical growths, the ultimate diagnosis should be made on the basis of a microscopic examination of the tissue itself. Even when there seems to be no room for clinical uncertainty, habit and routine should impose this invaluable laboratory check. In two of our cases, the diagnosis could not be established without the aid of the microscope. Maley diagnosed his case a sarcoma before he saw the microscopic sections. We repeat, therefore, that it is essential to have the clinical opinion confirmed by microscopic examination of the tissue removed.

### TREATMENT

In the treatment of gonorrhœal condylomata, it is necessary to remove the source of the irritation and infection and also to destroy or remove the local growth. It has been our experience that neither one of these measures is sufficient in itself—both are necessary. Thus, in the case of the patient with the massive cervical condylomata, the main focus of the infection was removed by extirpating the tubal and ovarian abscesses, and at the same time a supravaginal hysterectomy was done. But this radical procedure in itself had no effect whatever in removing or checking the development of the condylomata. It was not until the cervical canal was thoroughly cauterized and the growths were destroyed by this same means that they disappeared and the offensive discharge ceased.

Should there be no lesions in the uterus or the fallopian tubes, the cervical growth can be removed by incision or cauterization. Curettage of the uterus should not be done in the presence of condyloma, as it might merely give rise to an endometritis which would otherwise not usually occur.

The treatment of tuberculous condyloma is usually a more serious problem as the cervix is quite resistant to tuberculous infection and an advanced lesion in the cervix is apt to be secondary to active manifestations of the disease elsewhere. As such, it is the least important localization of a widespread infection. It is, therefore, advisable in these cases to proceed slowly and with sound indication. We see no reason, however, why local treatments such as cauterization which do not require an anæsthetic should not be carried out. We would prefer to remove or destroy such growths by means of the actual cautery rather than by excision with the knife, as the cautery opens up no blood channels and does not tend to disseminate the infection. The only case of tuberculous condyloma we have seen died of generalized tuberculosis following an excision of the infected cervix.

### PROGNOSIS

In gonorrhœal condyloma, the disease should not recur if the source of the irritation and the local growth are removed. In tuberculous cases, the prognosis depends entirely upon the nature of concomitant lesions which may be present. If handled with the proper precautions, the local condition in itself is not serious.

### CASE REPORTS

Case 1. Gyn. No. 25625. C. T., colored, single, age 25, admitted January 12, 1920. Diagnosis: Chronic pelvic inflammatory disease; tubo-ovarian abscess, right; condyloma of the cervix. Complaint: Pain in the lower abdomen, leucorrhœa. The family history is negative. The present illness dates from April, 1919. At that time the patient noticed that she had a certain amount of bleeding after coitus. Soon afterward she developed a profuse yellow vaginal discharge which had a bad odor but was not irritating. In July, 1919, she commenced to have sharp, cramp-like pains in the lower abdomen, located chiefly on the right side, radiating across to the left iliac fossa and into the right lumbar region.

The menstrual history is negative. The marital history is somewhat suggestive in that the patient at the age of 15, gave birth to an apparently normal child. Although she states that there were no complications during the puerperium, the absolute sterility which followed this pregnancy and the presence of an old pelvic inflammatory disease suggest that her infection might possibly date back to this puerperium.

*Physical examination.* Temperature, 100.4° F.; pulse, 106; respiration, 22. Wassermann reaction in blood, negative. White blood cells 11,200 hæmoglobin 70 per cent (Sahli). Blood pressure—115 systolic, 100 diastolic (tycos, auscultation). Urine, negative.

The general condition of the patient was excellent. The only abnormalities of note related to the gynecological condition. There was slight abdominal tenderness which was localized in the lower right iliac fossa, and which was not accompanied by rigidity, muscle spasm, or free fluid. There was no palpable abdominal mass. On pelvic examination the external genitalia were normal. There were a few fibromata mollusca which were scattered over the labia, the thighs and the groin. Bartholin's and Skene's glands were not involved palpably. The perineum was not relaxed significantly. The vaginal mucosa was normal. There was a profuse, thick, yellow discharge. The cervix was markedly hypertrophied, measured 7 centimeters across, was patulous and with the exception of a narrow strip on the posterior border was distinctly softened superficially, feeling very much like a piece of thick velvet. No discrete nodules could be felt. The posterior fifth of the cervix was normally firm and smooth (Fig. 1). The cervix did not bleed on light manipulation. The fundus of the uterus was pushed into the left fornix by a hard mass which filled the right half of the pelvis, was tense, moderately sensitive and densely adherent.

Rectal examination was negative.

On inspection the cervix presented a striking and unusual appearance. The posterior fifth of the cervix was white, showing the smooth, glistening surface of normal cervical tissue. The remainder of the cervix was replaced by a red polypoid mass consisting of numerous vascular papillomata, closely crowded together, raised about 1 centimeter over the strip of normal cervix, not ulcerated, with sharp borders both at the vaginal mucosa and on the posterior lip of the cervix (Fig. 1). Some of these papillomata presented little yellow crests consisting of purulent material which could be expressed with ease.

When palpated under vision, these papillomata were very soft, were not friable, would not break off, but would bleed on being rubbed as would a granulating wound. There was no tendency toward necrosis, sloughing, ulceration, caseation, or invasion. The cervical canal was not invaded by these papillomata and only on the right vaginal border had the process shown any tendency to pass beyond

the cervix. There were no secondary implantations or nodules in the vaginal mucosa.

*Treatment.* A small wedge of this tissue was removed for diagnostic purposes and the tubo-ovarian abscess was drained *per vaginam.* The convalescence was uneventful. Since the microscopic examination showed that the tissue was not malignant, the supravaginal portion of the uterus, both tubes and ovaries and the appendix were removed by laparotomy two weeks later. The patient left the hospital on February 18, entirely relieved of all her abdominal symptoms but still complaining of a profuse and purulent vaginal discharge.

She was then observed in the dispensary for a period of 2 months. During this time she used hot douches, general tonics, and was given local treatments without avail. The discharge increased in amount and occasionally was very bloody. On April 28, 1920, she was, therefore, readmitted to the hospital for the treatment of the cervical growth. It was then found that the condyloma had not changed in any particular under 2 months medicinal treatment. It, therefore, was destroyed with the actual cautery. Since that time the discharge has ceased absolutely.

*Pathological diagnosis* (No. 25662). Bilateral chronic salpingitis; tubo-ovarian abscess, right; acute oophoritis; normal endometrium; multiple condylomata of cervix, acutely infected.

Case 2. This case was reported in 1900 by Cullen in his volume on *Cancer of the Uterus.* At that time he stated that this was the only case of cervical condyloma of this type that had been seen in this hospital. This statement still holds true. To make the present series complete we shall include a short abstract of this case.

*Gyn. No. 6564.* B. B., colored; aged 17; admitted to hospital December 13, 1898; operated upon December 21, 1898; died January 22, 1899; Autopsy No. 1257; Pathological No. 2805. Clinical diagnosis: condyloma of cervix, tuberculous. Complaint: leucorrhœa; pain in lower abdomen and back.

The present illness was of 1 year's duration. The first symptom was a white malodorous vaginal discharge. Two months later the patient had an attack of fever which lasted for 2 or 3 weeks and was accompanied by pain in the back and lower abdomen, headache and thoracic pain, but no cough. The onset of menstruation occurred at the age of thirteen following which for 3 years the menses were quite normal in every respect. Since the onset of the present illness one year ago, the patient has had complete amenorrhœa. The patient has never been pregnant.

*Physical Examination:* The patient, a young colored girl, appeared fairly well nourished. The only positive findings were the signs of old tuberculosis lesions at the apices of both lungs, an evening pyrexia of 100°–101° F., and the striking pelvic abnormality. The cervix was replaced by a large lobulated mass which filled the upper third of the vagina. This mass was resistant but did not have the superficial friability of a squamous-celled carcinoma or the cartilaginous induration of an adenocarcinoma. It did not bleed on light manipulation (Fig. 3). Dr. Howard A. Kelly who operated upon this patient made the note that this growth looked "like an exuberant cockscomb, pinkish, with shallow sulci between the lobules." He also observed that in places the cervical glands were dilated and had the appearance of clear cysts which presented on the surface of the lobules. The picture as a whole reminded him of "exuberant granulation tissue which was filling a cavity left by an operation." The microscopic picture is described by Cullen in his volume on *Cancer of the Uterus,* page 195.

*Operation.* Under general anæsthetic, an attempt was made to curette away this mass. The curette, however, would hang in the resistant tissue leaving tags attached to the cervix and bringing away almost no material. An amputation of the cervix was therefore done.

During the first week after the operation, the convalescence was uneventful. The patient then commenced to have an evening rise of the temperature, symptoms of generalized tuberculosis set in and her decline was steady. She died on the thirty-second day after the operation.

The postmortem examination (Autopsy No. 1257) revealed the fact that the patient died of generalized tuberculosis which involved the endometrium, both fallopian tubes, the liver, spleen, kidneys, intestines, the retroperitoneal glands, the lungs, and brain. The lesion in the lungs consisted of an acute tuberculous pneumonia. The cervical growth was a massive tuberculous condyloma.

Case 3. Gyn. No. 9454. C. M., white, aged 36. Diagnosis: Condyloma of vulva, massive; condyloma of vagina and cervix. Admitted to hospital March 9, 1902; operated upon March 17, 1902; discharged from hospital April 10, 1902.

The patient entered the hospital complaining of leucorrhœa and a growth on the genitalia. For 4 or 5 years she had had a rather profuse white vaginal discharge which had become extremely irritating and offensive, especially since the birth of her last child in 1900. One year later the patient developed vulval condylomata which were removed but recurred promptly and had been growing rapidly during the year which preceded her admission to this hospital.

The patient had given birth to five children, all the labors and puerperia having been normal. Her menstrual history was practically negative with the exception that during the past year the menses had been becoming increasingly profuse and had been coming with greater frequency than normal. There had been no intermenstrual bleeding.

Examination showed that the perineum was covered by a massive vegetative condyloma which had involved all the external genitalia, the urethra, and the introitus. All normal landmarks had been

obliterated. There were a few condylomata scattered over the vaginal mucosa and a pedunculated mass was attached to the posterior lip of the cervix. The cervix itself was markedly hypertrophied and rather deeply lacerated. The fundus lay in retroposition. The fallopian tubes and ovaries were normal.

At the operation the condylomata were all excised, including the condyloma of the cervix. The convalescence was uneventful. The microscopic examination of the cervical growth showed that it was covered by squamous epithelium, the stroma was somewhat infiltrated by mononuclear leucocytes, and in the area beneath the growth there was a moderate grade of chronic inflammation.

## CONCLUSIONS

1. Condyloma of the cervix is one of the rarest of gynecological disorders.

2. Etiologically, pathologically, and clinically, there are two distinct types of condyloma of the cervix: the gonorrhœal and the tuberculous. When complications are not present, the symptomatology in these two types may be identical, the chief complaint being the presence of a profuse, purulent, vaginal discharge which may be occasionally tinged with blood. Both from the viewpoint of the history and the clinical findings, there may be no small resemblance between condyloma and malignant tumors of the cervix.

3. Gonorrhœal condylomata may occur singly as isolated pedunculated tumors or in clusters of papillomata which may almost entirely cover the cervix. These masses may present varying grades of inflammatory reaction. Gonorrhœal condyloma of the cervix may be accompanied by similar lesions on the vulva and perineum and also by salpingitis and its many manifestations, but in our experience the endometrium is not usually affected. The primary focus of infection appears to be in the cervical glands. In the treatment of gonorrhœal condyloma, it is necessary to clean up the focus of infection and also to remove the local growth. Curettage of the uterus is unnecessary and should not be performed.

4. Tuberculous condyloma of the cervix is almost always accompanied by other manifestations of the disease. There is almost always a concurrent tuberculous endometritis and salpingitis, and very frequently other lesions may be found. For this reason the operative treatment of the cervical lesion should be undertaken only after a careful study has been made and on the basis of sound surgical indication.

5. Prognosis. In gonorrhœal condyloma the outlook is uniformly good; in tuberculous the prognosis depends entirely upon the nature of the concomitant lesions and the method of treatment instituted.

NOTE.—I wish to express my thanks to Dr. Thomas S. Cullen for the numerous favors he has shown to me in the preparation of this short article. Also to Mr. Russell Leonard Drake, the artist who prepared the first two illustrations for me, I am most deeply indebted, and both to him and to Mr. Max Broedel (in whose department he is engaged) I express my sincere appreciation. I also take pleasure in acknowledging the courtesy shown to me by the publishers of Dr. Cullen's book on *Cancer of the Uterus*.

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# THE X-RAY AFTER THE INFLATION OF THE PELVIC CAVITY WITH CARBON DIOXIDE GAS AS AN AID TO OBSTETRIC AND GYNECOLOGIC DIAGNOSIS[1]

By REUBEN PETERSON, M.D., F.A.C.S., Ann Arbor, Michigan

ANY new procedure introduced as an aid to diagnosis must meet certain requirements before it will be generally accepted. It must be practical, that is, its technique must be such as to require no elaborate or complicated apparatus. Especially is this true if the diagnostic procedure requires the presence of the patient. For example, one of the most universally employed diagnostic procedures, the Wassermann test, does not need to conform to the above requirement, since blood can be removed from the patient and sent to a laboratory. Whether the result of the test has been arrived at by a simple or complicated technique is a matter of indifference to the average physician who makes use of this diagnostic procedure. The same applies to other routine laboratory tests.

Secondly, the new procedure must be safe where ordinary common sense precautions are taken. This means that there shall be nothing inherently unsafe about it in the hands of examiners of ordinary skill. For example, demonstration of spirochætæ by puncture of the skull may be a most valuable diagnostic procedure, but it will be employed only by experts because of the dangers of such a procedure in ordinary skilled hands.

The diagnostic procedure I am going to discuss this evening can not in any sense be called new, since it has been used since 1912 when Weber employed the X-ray after air inflation of the abdomen. The extensive, careful, and successful work of Stein and Stewart in New York is known to you all and practically has demonstrated that roentgen examination of the abdominal and pelvic organs after the introduction of air or gas into the peritoneal cavity is a safe and useful diagnostic procedure. However, the procedure has not been generally adopted, especially as an aid to the diagnosis of pelvic lesions, for reasons which will be set forth later.

I am free to confess that at the start I was prejudiced against the method. In my ignorance and egotism I was quite convinced that I could make a better diagnosis by bimanual examination than could be done by roentgen examination after peritoneal gas inflation. Again, even in spite of the testimony of Stein and Stewart, I was not at all convinced that the method was entirely free from danger. In fact it required considerable urging on the part of my X-ray colleague, Doctor Van Zwaluwenburg, before I seriously took up this work at the University Hospital some 6 or 8 months ago.

I was influenced to introduce this diagnostic procedure into my clinic by the work of another New York investigator, Doctor Rubin. While Rubin frankly states that his work with tubal peritoneal gas inflation has been and should be limited to the single diagnostic point of determining the patency or non-patency of the tubes, it seemed to me that the two methods, transperitoneal and transuterine gas inflation, could, in certain cases at least, be combined to advantage. In fact I believe that a clear realization of this fact will prove of immense advantage to the gynecologist.

First of all, let us consider the question whether or not pelvic roentgenography can be an aid to obstetric and gynecologic diagnosis. If the bimanual examination is all-sufficient, pelvic roentgenography would be an interesting but altogether unnecessary diagnostic procedure. The answer to the question depends entirely upon what is meant by a pelvic diagnosis.

Perhaps I can illustrate this best by some of our experiences in the University Hospital gynecologic clinic. We got into the very reprehensible habit of stating after bimanual examination that a given pelvis was inflammatory either on one side or the other or both. Upon the degree of the inflammatory process

[1]Read before the Chicago Gynecological Society, February 18, 1921. For discussion, see p. 222

as revealed by vagino- and recto-abdominal examinations rested the decision as to whether the case was or was not operative.

This word "inflammatory" was all inclusive. It included lesions of the tube, ovary, adhesions, etc., but no attempt was made to be definite as to what organs or tissues were involved in the inflammatory process. In certain cases this is very difficult and in certain other cases impossible of determination by bimanual examination. From experience with hundreds of cases with approximately the same feel to the examining finger, we draw our conclusions as to what this particular inflammatory mass probably is. However, in the past we have not been very exact because of the difficulties of stating definitely the particular tissues involved and because we knew full well that the matter would be definitely settled at the operation.

Granted that this practice and reasoning be correct, what about border-line cases? Is the tube or ovary enlarged or thickened? Are they adherent or freely movable? Failure to make definite diagnoses prior to operation inevitably leads to slipshod, careless, and often very unfortunate diagnoses or errors in diagnosis. I will even go so far as to assert that the very fact that the pelvic organs are easier to palpate with accuracy than are, for instance, such organs as the stomach or liver, leads to inaccuracy in diagnosis.

After some 30 years' experience in a special field of work I took it for granted there was very little to be felt in the pelvis that I could not feel. I must confess that after my experiences with pelvic roentgenography my eyes have been opened to the fact that there are possibilities in relation to preoperative diagnosis I never dreamed of.

These remarks are for those of you who are receptive, ready to take advantage of any safe procedure capable of aiding diagnosis. On the contrary my remarks are not addressed to those who are never guilty of preoperative mistakes in diagnosis, to those who are backed up by three or four diagnoses, so that there is little chance of missing them all; nor am I much concerned with the man who will deliberately lie out of a mistake in diagnosis. My remarks are addressed to those who know they make mistakes and are ready to place themselves in a position where such errors may be avoided in future. To these I will say that pelvic roentgenography has been one of the most helpful and interesting studies I have ever made. It has been of immense help not only to me but to all members of my staff. It has led to more careful diagnoses, to the study of diagnostic errors in order that similar mistakes may be avoided, in short it has given new life and impetus to our routine work. We still perform a certain number of exploratory laparotomies for the reason that at times we are uncertain as to the exact intra-abdominal and pelvic conditions even after all methods of preoperative diagnosis have been employed. However, I may add that such explorations are far fewer in number now than was the case 6 months ago. Moreover this improvement has been due both directly and indirectly to the use of gas inflation roentgenographic methods.

Prior to the demonstration by lantern slides of the technique and results of pelvic roentgenography as employed in the obstetric and gynecologic clinic of the University Hospital, I desire to lay before you certain facts which you may bear in mind while you are viewing the slides.

*Safety.* The pelvis has been inflated with gas in over 150 cases with no reaction which could be attributable to the gas itself or to the method employed. This coincides with the experience of Stein and Stewart with transperitoneal gas inflation and with Rubin where transuterine inflation is employed. The combined experience of several hundred cases is more valuable than pages of theoretical objections to gas inflation on the ground that the methods are dangerous. It goes without saying that modern surgical methods of sterilization must be employed, but this is true when we introduce a uterine sound or perform abdominal paracentesis.

Actual experience and animal experimentation have shown that there is no danger of injuring the intestines by the needle thrust through the abdominal wall where the intestines are not adherent to the parietes. Where the puncture is made in the presence of adhesions common sense would lead the opera-

tor to select a locality on the abdominal wall free from adherent gut.

*Discomfort from gas inflation.* Very rarely will a patient be found who will suffer no discomfort from the injection of enough gas into the abdominal cavity to insure a satisfactory roentgenogram. The discomfort is not connected with the passage of the needle for this can be rendered practically painless by local anæsthesia. The discomfort is associated with and caused by the rapid distention of the peritoneal cavity. The more gas injected the greater the discomfort, hence our efforts should be directed to elaborating a technique which will give a good pelvic picture with the minimum amount of gas.

The average patient will begin to complain of discomfort about the lower abdomen when 400 or 500 cubic centimeters of gas have been introduced. The discomfort increases with the amount of gas injected so that patients may complain very bitterly after the introduction of more than 1000 cubic centimeters. Rarely now do we find it necessary to inject more than this amount.

It has been our experience that chronic pelvic and abdominal peritoneal inflammation increases the amount of the discomfort. This is what one would expect since the gas undoubtedly by distending the peritoneal sac stretches the adhesions.

Discomfort is increased by the rapid injection of the gas. This also is what we would expect as the same thing can be observed in rapid distention of such organs as the bladder or stomach. Always there exists a tendency to inflate the patient more quickly than is necessary. This tendency should be controlled if we are to reduce discomfort to a minimum.

Further experience will undoubtedly lead to improved methods by means of which there will be practically no discomfort and certainly no pain connected with gas inflation. I am convinced of this when I see how little the patients complain now in comparison with what they did when the gas was introduced in large quantities and more quickly than necessary.

*The kind of gas to be used.* We first used oxygen gas but have abandoned it for carbon dioxide gas because the latter is absorbed in from 15 to 20 minutes after the inflation has been completed. I say absorbed although I have not determined this fact experimentally. At any rate the patient ceases to complain of discomfort 10 or 15 minutes after the gas has been injected. In one-half hour patients walk from the examining room or leave the hospital without any discomfort. This is not the case when oxygen has been used where patients suffer for hours unless the gas be removed by another abdominal puncture.

The rapid absorption of the carbon dioxide gas necessitates rapid work in taking the X-ray plate, but that simply means the perfecting of a smoothly working technique.

*Transuterine gas inflation.* We have made some changes in Rubin's technique of passing gas through the uterus and tubes into the pelvic cavity. The uterine cannula is introduced in the Sims' position since in this position a better exposure of the cervix can be made. In this way iodine sterilization of the cervix is easier and the cervix possibly better steadied by the tenaculum prior to the introduction of the cannula. The gas is passed with six excursions of the siphon meter to the minute and no higher pressure than 200 millimeters is employed, since we have found that pressure to be sufficient for the passage of the gas if the tubes be permeable.

If the gas passes freely the inflation is continued until between 500 and 1000 cubic centimeters have entered the pelvis. The plate is then taken exactly as if the inflation had been made through the abdominal wall.

In acute or subacute pelvic conditions the transuterine route is contra-indicated and is never employed. The same holds true for patients beyond the menopause.

*Transperitoneal route.* In by far the largest number of cases this route for one reason or another is the method of choice. In 105 inflation cases 77 were by the abdominal, 23 by the transuterine route while in 5 cases the transperitoneal method was employed after the tubes were found to be impermeable.

We have abandoned the gas bag inflation method of Stein and Stewart in favor of the simple accurate method of Rubin. By this technique rapidity and pressure can be

accurately gauged and the method has proved eminently satisfactory.

*Position of the patient.* To insure successful pelvic roentgenography, the patient must be so placed as to allow of the gas rising upward and displacing the pelvic organs and forcing the intestinal coils out of the pelvis. After many trials with different positions, we are securing the best results with the moderate knee chest position with an inclined board beneath the thighs with a notch cut out for the tubes. The table is then tipped, as for the Trendelenburg position, the patient being prevented from slipping by shoulder straps.

An 18-inch square of opaque fabric with a 6½-inch circular hole cut out of its center is laid on the buttocks and serves as a diaphragm. A plate-changing tunnel is then placed horizontally on the table, double screen films are used, and a Coolidge portable unit operating in the ordinary lamp circuit furnishes the X-ray. An exposure of from 14 to 20 seconds is usually required.

## SUMMARY

1. The uterus together with the tubes and ovaries can be clearly shown by pneumoperitoneal roentgenography.

2. Owing to their distention with gas the tubes are rather more clearly demonstrated by the X-ray where inflation has been brought about through the transuterine route than where the inflation has been made transperitoneally.

3. On account of the rapid absorption of carbon dioxide gas with equally rapid subsidence of the discomfort produced by the inflation, this gas should be used in preference to oxygen which is very slowly absorbed.

4. Irregularities of the uterus, omental and bowel adhesions are clearly demonstrated by the pneumoperitoneal X-ray.

5. In not a few instances the diseased and enlarged appendages are more clearly made out by pelvic roentgenography than by the most careful and searching bimanual examination even under anæsthesia.

6. With the improved position (knee chest and Trendelenburg) smaller and smaller quantities of gas will be necessary for inflation. Thus discomfort will be reduced to a minimum.

7. If the technique of pelvic roentgenography be good, retention of bowel coils in the pelvis will be proof of adhesions.

8. The pneumoperitoneal X-ray is able to demonstrate pregnancy at a much earlier period than is possible by the examining finger.

9. With good technique and good judgment in the selection of cases both transuterine and transperitoneal gas inflation are free from danger.

10. Bimanual pelvic examination and pelvic pneumoperitoneal roentgenography are not antagonistic diagnostic methods. Each is valuable and their value is enhanced if they be used in conjunction, each acting as a check upon the other.

# RADIUM IN CARCINOMA OF THE UTERUS[1]

By WILLIAM KOHLMANN, M.D., F.A.C.S., New Orleans, Louisiana

WITH the discovery of the remarkable power possessed by radium, this element has been eagerly adopted by the medical profession as a symbol of hope, offering prolonged life and freedom from suffering to a great number of cases of cancer which, formerly, would have been considered absolutely hopeless, and the only temporary relief for which was morphine, and this could merely alleviate the suffering for a short time, for soon even this means would lose the power of deadening the pain. In the past few years, radium has been more and more used in the treatment of malignant disease, and the excellent and surprising results achieved in many cases, especially as a palliative measure in inoperable carcinoma, could not fail to impress the profession with its importance as a valuable adjunct of surgery in the treatment of malignancy. Moreover, in many instances, it is not only an adjunct, but may be compared very favorably in its effects with the results obtained by surgical measures, and frequently, in cases where surgery fails, it will bring about relief and even apparent cure.

The unsatisfactory results achieved by surgery in carcinoma of the uterus, especially in carcinoma of the cervix of the uterus, are only too well known. The radical operation, which, through the efforts of Rumpf, Clark, Ries, and others, has been developed in the last decade of the past century and has been improved and perfected in many details by Wertheim—whose results, reported in 1898, showed a generally considered high percentage of cures—has been employed for a number of years. The high mortality of this operation in all except the early cases, even in the hands of the most competent operators, and the complicating sequelæ, which frequently follow the operation, soon brought this method into disfavor. Janeway[1] has given interesting statistics showing the results of this operation, and with scarcely any exception, his experiences are those of every operator. Considering the low operability, the high operative mortality, and the percentage of cures—which after all is low—the possibility of a new treatment, which promised better results, was generally welcomed.

In contrast to this drastic course of treatment, the palliative and even curative results by radium have been surprising, and this fact has brought forward a number of questions:

1. Whether radium should be applied only in inoperable carcinoma, and after surgery has failed;

2. Whether it should be used in assistance to surgery, as preoperative and postoperative radiation; or

3. Whether it should be given the preference, that is, as the only treatment without any surgical interferemce whatsoever.

In inoperable carcinoma, the treatment with radium is accepted today as the treatment of choice. It accomplishes, without any great risk, more than any other method of treatment, and in some instances the primary results achieved by its application have been quite marvelous. In the treatment of recurrent carcinoma after panhysterectomy the reported results are not satisfactory although some primary improvement can be noted. Twelve such cases came under my observation, of which number 4 died, 5 could not be traced (probably have died), 3 have been clinically well for 2½ years.

Preoperative radiation should have a distinct value, but should be followed by early operation, not later than 4 weeks. If radiation is repeated and operation is postponed, the tissue changes have progressed to such a degree that the surgical procedure is difficult. I have operated upon 4 such cases from 2 to 3 months after radiation. No special benefit could be noted in regard to the progress of the disease. As a routine treatment, I employ postoperative application of

Surg., Gynec. & Obst., 1912, xxiv, 242.

Read before the Southern Surgical Association, Hot Springs, Virginia, December 14-16, 1926.

radium. Nine cases have been treated in this manner, of which 3 have been well for over 3 years, 1 has been well for over 1 year, 1 is living but not improved, and 4 are dead.

Great care is necessary in the application of the radium because of the formation of cicatricial tissue due to the previous operation and because of the close proximity of the bladder and rectum. If particular attention is given to this fact, and careful screening applied, I believe the danger of fistula can be avoided. Postoperative radiation by the roentgen-ray might be preferably applied. I employed this method before radium was at my disposal.

In regard to the question as to whether radium should be the treatment of choice in early and operable carcinoma, there is no uniformity of opinion thus far. As, however, radiotherapy, in the course of time, is making itself more and more felt, we will soon have to make a decision as to whether surgery, combined with preoperative and postoperative radiation, or radium alone is to have the preference. He who believes that postoperative radiation is advisable is primarily a believer in radiation and he must be firmly convinced that radiation influences the carcinomatous tissue which may not have been removed—that it destroys cells for a certain distance, or at any rate that it checks their growth. During the last few years, I have had occasion to employ radium as the only treatment in a few early cases, where surgery, on account of complicating disease, was contraindicated. The results in these cases have been in the highest degree satisfactory, and so far the most extensive surgical operation could not have produced results to surpass those obtained, except that in one case, after primary improvement and apparent cure, there was a sudden fulminating recurrence, followed by death as the result of hæmorrhage. This case was complicated with diabetes, and it is possible that the constitutional disease was, to some extent, predisposing to the rapid, violent recurrence.

Von Seuffert mentions the fact that in constitutional diseases, lues, and especially diabetes, great care should be exercised. Six cases of this type have been under my observation. One has been free from symptoms for more than 3 years and has received no treatment; one has been free of symptoms for 1½ years and has had no treatment; two have been free from symptoms for 6 months; one could not be traced, and one died.

Cures of this kind seem to be more certain and one looks for less frequent local recurrences after treatment with radium since there is not the danger of spreading carcinoma cells over freshly cut surfaces and in this way grafting the malignant disease on to healthy organs which is likely to happen during an operative precedure.

Frequently, objection is raised to the use of radium in the belief that the claims made in its behalf are not justified. We must not allow patients and their attending medical advisers as well, to have the impression that radium is a sure and permanent cure in all, and especially in advanced cases, in which only palliative results can be expected. If radium is applied in early cases before metastasis has occurred, a cure may be expected. Unfortunately, however, it is hardly possible to fix such a time with any degree of certainty. In advanced cases where metastasis has already occurred, especially where glands at a greater distance are affected and which can scarcely be reached by radiation, permanent results cannot be expected.

This brings up the question as to how far reaching the effect of radium may be. The extent of the therapeutic effect of radium has yet to be investigated, and a great deal of experimental as well as clinical work must be carried on in the next few years. Such work is now possible with the increased quantity of radium at our disposal and the increased interest that the medical profession is taking in its application. This interest in itself, speaks for the general belief that great things are to be expected from radiumtherapy.

Radium radiation is considered effective at a distance of from 3 to 5 centimeters, depending on the quantity and quality of the ray. The radio-sensibility of the surrounding tissue must be considered too, as it varies in individual cases, no doubt, causing a marked irritability of the bladder and rectum in certain cases, and in others producing, with the

same dose, no such unpleasant, irritating symptoms.

The combination of roentgen and radium radiation will have to be considered in the future, in order to extend the area of radiation beyond the pelvis and to subject the iliac regions to the same intense treatment as has been applied to the pelvic cavity. More attention has been devoted to this procedure in recent years, and it has been discussed by Seitz and Wintz under the name of Roentgen-Wertheim.

The effect of radiation in cases of carcinoma can be noted clinically in a very few days after the application. Three or four days after the treatment, the infiltration and tumefaction of the cervix are diminished, a process which is gradually followed by the shrinking of the mass and infiltration of the broad ligaments. This action of radium is most probably due to the destruction of the carcinoma cells and an increase in the formation of connective tissue, which, by shrinking and cicatrization has a tendency to interfere with the life of the carcinoma cells.

Believing that a reduced blood supply and an increased development of connective cicatricial tissue are important factors in securing results with radium treatment, I have been using a method previously advised as an adjunct to cauterization, especially in extensive cauterization as recommended by Percy. This method consists in the ligation of the internal iliac and ovarian arteries prior to radiation, or simultaneously with the application of the radium. In this way I hoped to augment the effect of the ray by cutting down the blood supply and starving the diseased area. I have applied this method of treatment in 12 cases during the past 3 years. Five were not benefited and died, 6 show primary cure, 1 is unimproved but still living after 10 months. Of the six showing primary cures 1 is well for 1 year and 8 months, 1 is well for 1 year and 7 months, 1 is well for 1 year and 5 months, 1 is well for 1 year and 2 months, 1 is well for 8 months, 1 is well for 3 months. These cases were not selected, and two were so far advanced that the ligature of the ovarian artery was impossible on account of infiltration. It is my opinion that some of these cases have been materially benefited by this method. Cases of similar type under treatment at the same time, which were subjected to radiation only, did not improve, or had recurrence after temporary amelioration of the local and general symptoms.

Since June, 1915, 96 cases of carcinoma of the uterus have come under my observation in my private work and my service at the Touro Infirmary, and of this number 56 were treated with radium only. All the cases were examined microscopically and the clinical diagnosis of carcinoma was confirmed. With very few exceptions, all cases were benefited and showed improvement in regard to both general and local symptoms. Some of the cases had improved to such an extent that a cure could be hoped for. Cases which did not show improvement after one or two treatments have not been influenced, as a rule, even after prolonged treatment. Recurrences after apparent clinical cure by radium were observed mostly in 6 to 9 months, and further application in these cases has been without benefit. Almost all of these cases have been of a very advanced type, and it is doubtful whether any other method of treatment could have been employed without immediately endangering the life of the patient. Even if there were no marked results in regard to a permanent cure, the palliative influence on the local and general symptoms was remarkable.

Of 22 cases living today 1 is well for 4 years, 1 is well for 3 years, 2 are well for 2 years. (One of these has vesicovaginal and rectovaginal fistula.)

The remaining cases of this group have been under treatment for less than 12 months.

Of 22 cases which have died 2 had been well for 3 years, but died of intercurrent pneumonia; 1, a woman of 39 years, died, free of recurrence for 1½ years.

The time of observation for the entire series has been too short to be able to speak of any permanent cure, or even to compute a percentage, but the outlook is hopeful that, at the end of a five year period there may be a fair percentage living, especially of the early cases, which were treated by radium only.

To simplify the survey of the results, I have divided the cases into three large groups:

*Group 1:* Carcinomata which are early and easily operable: (a) Cases treated with radium only. (b) Cases with panhysterectomy and postoperative radiation.

*Group 2:* Carcinomata, that are doubtful and inoperable: (a) Cases treated with radium. (b) Cases treated with ligation and radium.

*Group 3:* Recurrence of carcinoma after panhysterectomy.

| | *Living* | *Dead* | *No Report* | |
|---|---|---|---|---|
| *Group 1:* | | | | |
| a. | 4 | 1 | 1 | 6 |
| b. | 5 | 4 | 0 | 9 |
| *Group 2:* | | | | |
| a. | 22 | 22 | 12 | 56 |
| b. | 7 | 5 | 0 | 12 |
| *Group 3:* | 4 | 4 | 5 | 13 |
| | | | | Total 96 |

In regard to the treatment, I am greatly indebted to Drs. Samuel and Bowie, radiotherapists of the Touro Infirmary, for their valuable assistance and co-operation. The technique that has been followed in the application of the radium has been extremely simple. The silver tubes, 1½ millimeters thick, each containing 25 or 50 milligrams of radium, after being placed in a 3-millimeter brass filter, are covered by a soft rubber finger cot, the end of which is tied. This cot is then put in the cancer crater which is present in most advanced cases and allowed to remain for 12 hours. The vagina is packed with sterilé gauze to protect the rectum and bladder as far as possible. No retention catheter is employed. After one application, the mass usually shrinks and a second application is then made intracervically. Fifty milligrams of radium covered by a celluloid capsule is introduced into the cervix, and 50 milligrams or more put into the still existing crater, or upper part of the vagina, and held there by a gauze pack.

In most cases, these applications were made in 8- to 10-day intervals, and then the patient was asked to return every 4 to 6 weeks for examination. If, upon examination, the patient was found improved, and some infiltrated tissue was still present, applications were repeated. In cases where no improvement could be observed, further treatment was without success. Many cases had been clinically well after 3 months. I have followed the rule of applying radium at intervals of 3 months in all inoperable cases which had clinically improved. In the earlier cases, no further treatment was employed.

During the past year, there was some slight variation in the method of treatment, and this change has proved so far quite satisfactory and is rather more convenient to the patient. The time of the first application is prolonged to 24 hours, and repeated after 6 weeks for the same length of time.

### HISTORY OF CASES

Case 1. Mrs. St. M., age 51. T. I. No. 61,350. Up to 8 months before treatment patient had been in good health. The menses were regular; every 28 days, lasting 4 days and were without pain. Since treatment there has been a slight vaginal discharge with blood, no odor. The patient has lost weight.

Vaginal examination revealed an enlarged cervix with the posterior lip especially thickened and ulcerated. A diagnosis of carcinoma was made and confirmed by microscopic examination of a small section. As the patient had symptoms of an early pulmonary lesion, a radical operation was not advisable.

*Treatment.* On July 19, 1917, 50 milligrams of radium were given vaginally; on July 30, 1917, 50 milligrams, and on August 8, 1917, 25 milligrams. The patient began to improve, the vaginal ulceration entirely disappeared, and on September 10, 1917, 50 milligrams of radium were given intracervically. Since treatment the patient has been under observation and the last examination showed the cervix small, soft, and smooth.

Case 2. Mrs. V., age 55. T. I. No. 74,645. Menses stopped 2 years before (?). Patient had vaginal discharge for few months. The attending physician advised treatment with radium in preference to operation because patient had heart lesion. The cervix uteri was enlarged and ulcerated and microscopic examination proved malignancy. The patient was at the time suffering from symptoms of cardiac decompensation.

*Treatment.* On May 6, 1919, 50 milligrams of radium were given for a period of 8 hours; May 13, 1919, 50 milligrams for 8 hours; May 20, 1919, 50 milligrams for 8 hours; June 24, 1919, 50 milligrams for 9 hours; and September 9, 1920, 75 milligrams for 12 hours. After a few days the cervix became small and smooth and there was no discharge.

Case 3. Mrs. M. A., age 46. T. I. No. 74,713. The patient suffered from a vaginal discharge at times bloody, every few days. The menses were regular every 2 or 3 months. The cervix was thickened, enlarged, and the posterior lip was ulcerated. A rush diagnosis was made of carcinoma.

*Treatment.* On May 10, 1919, after curettage 50 milligrams of radium were applied intracervically; on May 17, 1919, 50 milligrams of radium were applied intracervically and 25 milligrams vaginally; on May 24, 1910, the patient showed improvement and the cervix felt small and smooth; on September 28, 1919, the patient still continued to do well and was apparently cured—75 milligrams of radium were applied for 12 hours; on January 6, 1920, the patient returned. The posterior lip of the cervix was entirely destroyed, the vaginal wall was infiltrated. She had a severe hæmorrhage at home and had continued bloody discharge. Seventy-five milligrams of radium were given vaginally for 12 hours. There was no relief and patient died a few weeks later.

Case 4. Mrs. L. T., age 39. T. I. No. 55,783. The patient had been losing blood from the vagina for 3 months. There was no pain, she did not lose weight. Vaginal examination showed an ulceration of the cervix and slight involvement of the vagina.

*Treatment.* On August 28, 1916, 50 milligrams of radium were applied intracervically for 12 hours; on September 7, 1916, 50 milligrams were applied vaginally for 12 hours; and on September 30, 1916, 75 milligrams were applied vaginally for 10 hours.

Case 5. Mrs. E. DeM., age 48 years. T. I. No. 84,529. Patient suffered from ulceration of cervix with a good deal of discharge for about 6 months.

*Treatment.* On August 4, 1920, 50 milligrams of radium were given intracervically for 24 hours; and 50 milligrams vaginally for the same time; on September 8, 1920, 100 milligrams of radium were given vaginally for 24 hours. Cervix smooth and normal.

Case 6. Mrs. M. E., age 48. T. I. No. 85,610. The patient suffered from carcinoma of the cervix with ulceration over the posterior lip of the cervix.

*Treatment.* On September 28, 1920, 50 milligrams of radium were given intracervically for 24 hours; October 29, 1920, 50 milligrams were given vaginally for 8 hours. The ulceration disappeared.

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# THE HISTOLOGICAL CHANGES INCIDENT TO RADIUM AND X-RAY TREATMENT OF UTERINE CARCINOMA

By DOZENT DR. O. FRANKL and DR. I. AMREICH, Vienna

To determine the gradual changes brought about by radium and X-ray therapy and to standardize the technique of application, we have attempted to learn by means of a study of serial sections of excised tissue taken at different intervals from the crater and its edge in carcinoma of the uterus, at what time the action of radium or the rays is greatest and the point at which the effect of the rays or radium begins to lessen. We proceeded as follows:

*Radium.* A series of five treatments was given, each covering a period of 12 hours, at intervals of 1 to 2 days. We used 50 milligrams of radium in a platinum or brass filter with 1 centimeter cotton and rubber condon.

*X-ray.* We used a symmetrical apparatus, raying at a focal distance of 22 centimeters and giving a maximum dose of 18 Holzknecht units, filtering through 3 millimeters of brass, 0.5 millimeter of zinc, wood or chamois four times as thick; 3 milliamperes, 11 Benoist, 40 minutes per field. Eight to nine fields were covered, three or four in front, four in back, and one in the perineal region. In the first series the portio was treated, in the second the parametrium, and in each eight or nine fields were covered. The second series was given after 6 weeks.

We shall cite first our notes from a case of papillary carcinoma with small, densely packed cells of an immature type with extensive involvement of the stroma, for in this case we were able to make a precise study of the changes produced by the radiological treatment. Three days after the first treatment the tissue excised from the crater showed œdema of the stroma and the formation of œdematous lacunæ together with a number of intact carcinomatous nests. There was also extensive vascularization. Examination of a small piece of tissue from the edge of the crater showed no marked changes. Four days after the first and 12 hours after the second treatment, we found that the carcinoma cells directly played upon by the rays were greatly swollen, the nuclei were increased in size but well stained; the stroma showed loosening and œdematous changes; the alveoli were surrounded by an œdematous fluid preventing

the stroma from adhering closely to the epithelial nests. Pieces of tissue taken from the edge of the crater presented similar changes: slight œdema and in certain places enlarged carcinomatous cells. On the fifth day after the first, and 12 hours after the third, treatment we saw in those portions directly exposed a very marked œdema, the pseudopapillary tissue enormously swollen and the vessels in these papillæ (which were elongated and thickened) dilated. Epithelial cells were found detached from the nests and scattered in the detritus. On the sixth day after the first treatment we noticed the same sort of changes at the edge of the crater; œdema separating the stroma from the alveoli of the carcinoma and numerous detached cells within the œdematous areas. The carcinoma cells were greatly increased in size. On the seventh day we found the nests almost destroyed, the cells broken up into débris and a few cells lying in the periphery indicating the former extent of the carcinoma. In the centers were a few nucleated cells, also hyaline remnants of greatly enlarged carcinoma cells. Areas of œdema were present and the immigration of lymphocytes caused loosening of the carcinomatous cell masses.

Exactly the same changes were observed in the portions which were only directly exposed to the rays. Vacuolization was a distinct feature of the histological picture. On the ninth day after the first, 3½ days after the fourth, treatment we saw in the portions indirectly treated changes which indicated a turning point in the effect of the rays; the alveoli were broken up, the cells showed enlargement, vacuolization, and hyaline changes. On the tenth and eleventh days we found a breaking down of the nests of carcinoma cells and penetration by the lymphocytes. These changes occurred in the portions which were exposed either directly or indirectly to the rays. On the eleventh day the areas indirectly rayed showed in the center of an alveolus composed of vacuolized cells a number of proliferating carcinoma cells which indicated that the action of the rays was becoming less effective. Passing to the twenty-sixth day after the first treatment we found that the areas which had been directly rayed showed scattered remnants of carcinomatous tissue with very few cells surrounded by hyaline and structureless cell aggregations. Forty-one days after the first treatment, we found, besides altered tissue masses, rapidly proliferating carcinoma cells resembling those present before treatment.

We therefore concluded that the areas directly exposed to the rays showed the first changes on the third and fourth days; that that influence of the rays was greatest between the fifth and seventh days; and that the rays were no longer effective after the fortieth day, when the genoceptors of the cells became active and caused proliferation. Areas indirectly treated were slower in showing the changes and the effect wore off sooner.

Comparing the results obtained from X-ray treatment and radiumtherapy, we find the same histological changes: first œdema, then enlargement of the cells and the carcinoma-nest penetration of lymphocytes, vacuolization, and other changes found after such treatment. On the whole, we found that the changes took place sooner after treatment with the X-ray than with radium. One point should be emphasized and that is that in a case which reacted very favorably to X-ray treatment there was complete omission of the stage of enlargement of the cell. This change does not seem to be desirable in radiotherapy; it is rather a form of cellular regression and does not lead to cell destruction. Our specimens show that swollen cells may proliferate in every part of the alveolus. The nutriceptors are apparently injured to a greater extent than the genoceptors and only the complete elimination of the latter prevents proliferation of the carcinomatous tissue.

## SUMMARY

There are distinct differences between direct and indirect ray treatment. Carcinoma cells respond more quickly to the action of the X-ray than to radium and do not show the stage marked by the swelling of the cell body. These facts induce us to advise the use of the X-ray in treating the parametrium and the glands, while the use of radium is preferable in treatment of the carcinomatous crater.

# REMOVAL OF VENTRAL TUMORS OF THE SACRUM BY THE POSTERIOR ROUTE[1]

By HERMAN E. PEARSE, M.D., F.A.C.S., Kansas City, Missouri

VENTRAL tumors of the sacrum first described and brought into surgical literature by Middledorph[1] form an interesting group. The name "Middledorph tumors" clings to them although Law's name of "ventral tumors" of the sacrum is perhaps better nomenclature.

These tumors interest the operating surgeon through the oddity of their origin and placement, the difficulty of their removal, and their dangerous habits of rapid growth and greedy encroachment upon bladder, bowel, and ureter. They interest and puzzle the pathologist by the varied character of their cell formation and by the structural anomalies they present. The confusion of the amateur pathologist who attempts their study is only exceeded by the confusion of the amateur operator who attempts their removal. Both will have occasion to wish themselves well out of the case.

In 1912 Law,[2] of Minneapolis, read before this society an article entitled "Ventral Tumors of the Sacrum" in which he gave a clear account of the origin and development of these tumors and their minute as well as gross anatomy. Their origin seems well established. Embryonic remains they surely are. Their many-sided pathology; the variations in their microscopic structure; the confusing reports from laboratories as to their classification; the varying cytology of these tumors may be well accounted for by extensive development which normally and anatomically grows from the wolffian bodies, and it is from these wolffian bodies with their embryonic cycles of origin, function, degeneration and quiescent persistence that these tumors oftenest spring. They lie in the region where in the embryo the neural canal differentiates itself from the intestinal canal and where the wolffian body becomes the renal system, and the wolffian duct becomes the vas deferens in the male, and degenerates in the female. It is here in the adult that bladder, ureter, bowel, and vas are contiguous. The tumors lie ventral to the cup-shaped cavity of the sacrum. They shove their bulk forward and can be felt above the pubic bone, and when large may be seen there. They thus invite attack by ventral incision and the literature shows cases that have gone on to serious, even fatal condition, owing to the destruction of tissue, the difficulty of controlling hæmorrhage, and the infection of the operative field incident to an operation that traversed the peritoneum to reach the seat of dissection and excision; yet the dorsal position for the operative case is such a common one that unless carefully instructed a house service is apt to present such a case prepared for ventral section. An added invitation to suprapubic attack is the error in diagnosis that so often records these tumors as intraperitoneal, ovarian, parovarian, or uterine. When such an attempt is made and the abdomen opened in front in the lower middle line, an operator who has not attempted such a task before is inclined to go on and shell out the tumor which he finds behind the pelvic viscera. He is working deeply and the control of hæmorrhage is difficult. As he progresses his difficulties increase. Realizing perhaps the futility of completing the removal of such a growth from a suprapubic incision, the surgeon may supplement it with an attack by the perineal route only to be balked by the bowel and ureter pushed down by the growth. There remains the attack by the sacral incision. While a posterior incision and a sacral resection is an ideal way to reach these growths, it is practically impossible to do it supplementary to an abdominal incision. Rules of technique are outraged.

It is the purpose of this paper to call attention briefly to these tumors and the reasons for their removal by the posterior route. Kocher in 1874, and many writers since his

[1] Middledorph Arch. f. Path. Anat. etc., Berl., 1886, vi, 17.
[2] Tr. West. Surg. Ass., 1912.

Read before the Western Surgical Association, Los Angeles, December 3-4, 1920.

time have invaded the pelvis, at least the posterior inferior pelvis by way of the sacrum, but Kraske, of Frieburg, established and published the technique that met the approval of the surgical world, and his name by common consent is given to the procedure of opening the pelvis by resection of the sacrum. The essentials of sacral resection for removal of tumors from the pelvis are that:

1. The patient be placed on his face with pelvis well raised and thighs flexed.

2. An incision be made from just posterior to the anus upward in the middle line and carried above the coccyx; then curving to the left it follows the left edge of the sacrum. It is carried down to the bone and dissected outward right and left exposing the edges of the sacrum and the sacrosciatic ligament, and carrying the edges of the gluteal muscle.

3. The third sacral nerves must be identified and the sacrum divided below them. They should if possible remain intact. The central canal of the sacrum should not be opened. The attachment of the sacrosciatic ligament to the coccyx should then be severed, also the lower sacrum should be freed with a blunt dissector from all connections. The amputation is best done with a wire saw. The use of chisel and mallet here causes shock.

4. Thus the field lies before us. All bleeding is arrested and the growth attacked according to its location, attachment and adhesions.

From this point the operation may be of any severity, usually it will be exceedingly simple. All Middledorph tumors should be attacked from this direction for the following reasons:

1. They lie directly in front of the sacrum. When it is lifted off they can be studied in plain view.

2. They can then be removed systematically without disturbing the remainder of the pelvic viscera.

3. The peritoneum is not opened in reaching the tumor. If it is opened later in the removal it is not traversed and infected, and its contents may be protected.

4. The cautery may be used freely without damage to other structures.

5. Extensive tissue removal in handling the tumor's connections in muscle, fat and fascia, even bone, can be made quickly, safely and extensively because in plain sight.

6. Scar recurrence is in plain view and accessible to secondary operation.

7. Blood supply and nerve supply can be seen and easily attended to.

All of these reasons are anatomical; have to do with technique; are more or less self-evident. The sixth one calls upon us to go a bit more into the pathology of these growths, as it touches the treatment of their recurrence in or about the scar after operating for their removal. They are pathologically and clinically malignant. Their malignancy is clinically of the nature of the sarcoma. They travel along lines of blood supply. Their metastases are into muscle and fascia and fatty tissue oftener than in lymph nodes. Their recurrence is along scars made for their removal. They show the cytology of hypernephroma or nerve tissue or mixed tumors when the pathologist examines them, but to the eye of the clinical surgeon they follow the habits of the sarcoma.

Mr. D. B. H. of Verona, Missouri, came to my service in St Luke's Hospital, March 15, 1915, complaining of pain down in the lower bowel so constant it required opiates. He was 63 years of age, a lumberman, referred to me by Dr. Loveland.

The patient suspected lues 20 years ago. He had been fairly well treated and for 2 years had no relapse. There had been no subsequent manifestation of the disease.

*Present illness.* Beyond the pain in the pelvis there were no other symptoms. Two years ago he had noticed for the first time pain over the tip of the spine. He went to St. Louis and saw Dr. C. who sent him to Dr. F. Neither gave him a diagnosis. He then went to Hot Springs and was treated for lues. Afterward he was given several salvarsan treatments at Springfield. The antiluetic treatment did not help the pain. The patient was constantly in pain between times. The pain became excruciating when bowels acted. About a year ago he began to take antipyrene, codein and phenacetin to stop the pain. Wassermann negative.

*Physical examination.* Two weeks before the operation the examining finger came upon a more or less cystic feeling tumor in front of the coccyx and lower sacrum. It was almost in a mid-line and could not be moved by backward pressure.

*Diagnosis.* Ventral tumor of the sacrum; teratomatous in origin; congenital in development; sarcomatous in degeneration. Removal advised and accepted.

*Operation.* March 31, 1915. An incision was made from the left posterior superior iliac spine and

curved in toward the central portion of the sacrum down to the anus. The tissues were separated from the tip of the coccyx and rectum by blunt dissection, also separated from the face of the tumor. It was found on each side of the coccyx the tumor had involved each gluteus maximus. The involved portion of these muscles were cut about three-fourths of an inch to an inch on the outside of the tumor. The third sacral notch was found and the sacrum fractured across with a large chisel at this level. At this time the patient suffered extreme shock, and the blood became very dark. The tumor was rotated out of its position and found to be limited above by the peritoneum. The blood vessels were secured, the tumor removed, and all bleeding stopped; the skin was approximated. Two drains were inserted, one on each side of rectum, and the patient was put back to bed.

Shock reappeared several times the day of operation. Drainage was out in 24 hours. The patient had perfect use of his limbs when recovered. All pain ceased when operation was completed. No pain since.

September 1, 1915. The patient complains of a feeling of prolapse when bowels move, due, it was found, to the cutting away of the attachments of the levator ani muscle. An ingenious truss by an instrument maker relieved this.

October 22, 1917. Patient is well. No trouble since relieving the anterior rectal displacement by a brace lifting the perineum. Muscles became stronger except now he has a return of pain. Rheumatism in left leg from hip downward.

September 11, 1919. Patient returned with tumor to left of scar. This tumor was small, movable, but attached to the muscles. He entered my service at the Research Hospital and was operated upon September 12, 1919. Incision was made according to, and following the line of the former operation. At the lower angle of the incision, a hard tumor about 1 inch in diameter by ⅞ inch in length, was encountered. This was lying on the fascia involving the fascia and also the gluteal muscle. All portions of muscle and fascia involved were removed. The tumor had not attached itself to the bowel. The entire tumor and surrounding fat, fascia, and muscle were taken out and referred to the laboratory. The pathologist's report showed the growth to be hypernephroma.

The patient made an uninterrupted recovery, and was discharged October 4, the wound granulating nicely.

November 4, 1919. Patient writes that he is getting along very well. Is feeling fine, and helping to look after his business.

June 9, 1920. Patient reported at office. Examination shows a lump the size of hazel nut and movable in the upper part of the scar. Also a larger lobulated tumor high up on the right side under the right gluteal muscle.

June 9, 1920. He entered my service at St. Mary's Hospital and was examined by several members of the staff. The malignant nature of the tumor was conceded because of its recurrence. He was X-rayed thoroughly before operation as follows: June 11, 1920, by 4 points of entry posterior; June 12, 1920, by 5 points of entry posterior; June 13, 1920, by 5 points of entry anterior; June 14, 1920, by 5 points of entry posterior.

The X-ray work was by a Coolidge tube 9½-inch spark gap, for 7 minutes, protected by 6 filters of aluminum, 5 milliamperes of current, 8-inch target-skin distance. This being completed he was operated upon June 15, 1920. The operation sheet shows the following record: The incision went to the left of the first incision of 1915 which had left a clean soft scar. The removal of the lower sacrum left the tumor (recurrent) in plain view covered only by skin and fascia. It was very easily removed and offered but few obstacles. It was extremely simple compared with what would have been the case if operation had been attempted by any other route.

Four nodules were found, the smallest one 0.5 inch in diameter; the largest, 1.5 inches. The lowest was in the levator ani muscle fibers, the others were in the gluteal muscle. All were removed very wide of disease. The rectum was not opened but it was exposed for 6 inches. Care was taken to provide against prolapse of tissues by suture of the fascia to the former scar. Drainage was provided and the wound closed.

There was no shock and no delay in commencing convalescence. After examination of all tissue removed, and a careful review of the case history the diagnosis of hypernephroma was abandoned by the members of the Pathology Club and the original diagnosis of Middledorph tumor of neural origin was confirmed by them.

The patient's progress record shows the following entries:

June 15, 1920, patient had no shock, he awoke hoarse with a laryngitis; June 16, 1920, same condition of throat; June 17, 1920, removed tubes and packing from sacral wound; June 19, 1920, a little hoarse, otherwise doing well; June 21, 1920, post-operative microscopic report hypernephroma by the pathologist of St. Mary's; June 25, 1920, packing wound with balsam of Peru and castor oil because of a breaking down of the lower end of the wound, wound has gray appearance at lower angle; June 26, 1920, patient is doing well. The gray appearance of the lower end of the wound has disappeared somewhat under castor oil and balsam of Peru treatment. Patient is to be discharged today and to place himself under the care of the family physician who will be directed as to treatment. He will return at intervals of 3 weeks for further X-ray treatments and region is to be carefully watched.

The ease of approach; the ease of future observation and of future reoperation and the freedom from disturbance of other organs

marks the posterior route as the best route for the removal of these tumors.

The patient has since returned and has been X-rayed with a 9½-inch spark gap 4 times at intervals of 3 weeks receiving 5 milliamperes of current at each port of entry. He was treated through "24 ports of entry, fore and aft," at each series. The value of having all scar tissue readily accessible to X-ray again emphasizes the desirability of the sacral resection route for removal of these tumors.

NOTE—June 20, 1921. The patient returned for examination 1 year after the third operation and 9 months after his last X-ray. There is no evidence of recurrence.

# A CRITICAL STUDY OF AN ORGANISM ASSOCIATED WITH A TRANSPLANTABLE CARCINOMA OF THE WHITE MOUSE[1]

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SINCE Jensen's observation in 1901 that a spontaneous alveolar carcinoma occurring in the breast of a white mouse could be transplanted into normal white mice, many investigators have studied the transplantable tumors of the lower animals in countless laboratories throughout the world. Information of great value has accumulated therefrom. The transplantation of minute fragments of the original tumor into the breast tissues of other mice gives rise to a very small percentage of tumors in the first generation. Subsequent inoculations gradually yield a larger percentage of takes. After several animal passages the tumor virulence or adaptation may be so enhanced that tumors identical in structure with the original carcinoma grow in from 60 to 100 per cent of the mice so inoculated.

It is generally believed that the transplantable carcinomata arise from small peripheral islands of cancer cells which survive the transfer. The specificity of the cancer cell, i.e., the fact that these tumors are transplantable only in mice tends to throw the cancer problem into the category of tissue grafting in general.

The study to be reported has been conducted during the past 2 years with a transplantable mouse carcinoma originally received through the kindness of Dr. F. C. Wood.[2] It is known in his laboratory as the Crocker Fund Carcinoma No. 11. This tumor has been transplanted through more than one hundred generations of white mice. Its virulence is such that it now yields from 60 to 100 per cent of successful takes under favorable conditions.

When inoculated into the loose subcutaneous tissues of the white mouse the tumor grows by expansion rather than infiltration, giving rise to larger encapsulated growths. These ulcerate commonly at the end of 5 to 6 weeks, producing cachexia and death of the animal. Metastases rarely occur when the tumors are inoculated subcutaneously. If the tumor cells are inoculated into the solid viscera of the mouse, i.e., into the liver or spleen, the cancers gradually tend to grow by infiltration and metastasize into the various organs of the body retaining essentially the same histological structure. Hence it would appear that the distinctions between benign expansive and malignant infiltrating growth are not rigidly maintained in the transplantable tumors of mice.

An incomplete review of the voluminous literature on cancer shows that various bacteria as inciting agents have been incriminated by numerous investigators in their ceaseless search for a "cancer parasite." But in each instance the critical etiological proof, i.e., the production of genuine carcinoma by the inoculation of bacteria in pure culture, has failed.

[2] A part of this investigation was conducted in the surgical clinic of Dr. George W. Crile at the Lakeside Hospital, Cleveland, during the past summer. The writer wishes to take this opportunity to thank Dr. Crile and his associates for every kindness shown him.

[1] Read before the Chicago Surgical Society, May 6, 1921. (For discussion see p. 295.)

Peyton Rous[1] has shown conclusively that several different varieties of sarcomata in fowls may be due to a filtrable agent or virus. The virus passed Berkefeld filters which held back all tumor cells. Moreover, the tumor-producing agent resisted dessication and reproduced new tumors after preservation in the dried state for 7 months in the icebox. From his careful study he concludes that two factors are concerned in the causation of chicken sarcomata; one the cell itself and the other a filtrable agent. Either one or both agents may act to reproduce the sarcoma.

Still more suggestive is the recent work of Keysser[2] who has been able to transmit both human carcinoma and sarcoma to white mice by injection of a fine watery emulsion of human tumor cells into the solid viscera of the mouse. Furthermore, he was able to transplant these tumors into subsequent generations of mice observing a steady increase both in virulence and percentage of takes of the inoculated tumors. Since the tumor cells of man cannot live in a foreign host such as the white mouse, the conclusion seems irresistible that the cancer cells may carry with them some other agent which is the real inciting cause of carcinoma.

After 7 years of experimental study on the tumor problem in collaboration with Wassermann, Keysser emphasizes the fact that only under certain conditions has it been possible to obtain his important results, viz., the tumor cells must be at their maximal degree of virulence. His observations throw a new light on the cancer problem.

In order to determine whether or not some living micro-organism capable of cultivation might not be found associated with the tumor cells, acting possibly as a constant irritant to the cell nuclei, the following bacteriological studies have been made:

METHOD OF CULTIVATION

A large series of white mice was inoculated with sterile grafts of the Crocker carcinoma No. 11 by means of a trocar introduced into the subcutaneous tissues and more often into the groins or axillæ. In other instances multiple injections of the sterile, fine, watery tumor emulsion were made into the liver and peritoneal cavity. The tumors were removed aseptically when about 1 centimeter in diameter and inoculated into various solid cultural media under aerobic and anaerobic conditions. No growth resulted aside from occasional contaminations using the ordinary solid cultural media.

Inoculations of the carcinoma fragments into tubes of tissue ascitic fluid media overlaid with sterile paraffin oil or solid petrolatum, according to the method introduced by Theobald Smith and employed more exclusively by Noguchi, Foster, and others in the cultivation of filtrable viruses, has given results of an entirely different nature.

The culture media found most suitable consists of sterile human ascitic fluid. Into tall test tubes about 20 by 1.5 centimeters a fragment of sterile rabbit kidney or brain tissue is transferred and the tissue covered with 10 to 15 cubic centimeters of ascitic fluid. The ascitic fluid is next overlaid with 3 to 4 cubic centimeters of sterile paraffin oil. In other instances solid paraffin of a low melting point has been utilized to effect partial anaerobic conditions. The entire batch of tubes is now incubated for 3 to 7 days. Any tube presenting gross turbidity or gas formation is discarded forthwith as contaminated. With careful technique, the majority of tubes remain brilliantly clear. A sterile Pasteur capillary pipette is inserted down to the region of the tissue fragment and stained smears prepared further to safeguard against contamination.

For each individual mouse tumor five or more tubes of the media are now inoculated with fragments of the cancer tissue aseptically removed. Needless to say, necrotic or ulcerating tumors were not cultured. Control tubes both with and without the kidney tissue and paraffin oil were routinely incubated with the cultures.

The ascitic fluid employed must be bile free, of good specific gravity and originally sterile. Fibrin content enhances the value of the media. Several hundred cultivation experiments have shown that not all specimens of ascitic fluid are favorable for the growth of the

[1] Rous, Peyton, Resistance to the implanted tumor cells. J. Exper. Med., 1913,

organism in question. Moreover it would appear that storing the ascitic fluid in the ice-box for periods of several months enhances its cultural value. An original growth of the organism has never been obtained on solid media. Once a culture has been isolated in the kidney tissue ascitic media, it is usually possible to recover the organism in subculture generations where it grows with increasing ease after previous adaptation to artificial cultivation.

### CULTURAL AND MORPHOLOGICAL CHARACTERISTICS

The peculiar micro-organism obtained from mouse carcinoma tissue exhibits the following growth characteristics. Commonly at the expiration of 48 to 72 hours' incubation, a distinct, grayish white opalescent halo appears about the carcinoma tissue at the bottom of the tube of ascitic fluid. Gentle agitation of the tube tends to increase the degree of turbidity while the uppermost limits of the cloudy zone remain sharply demarcated from the clear fluid above. Further incubation serves to increase the degree of turbidity. The control tubes of tissue ascitic fluid routinely incubated with the cultures remain brilliantly clear. Only after several weeks' incubation does a granular precipitate of tissue particles form in the bottom of the test tube.

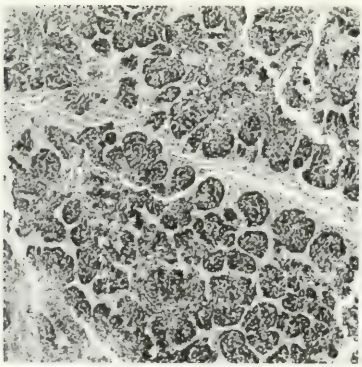
Occasionally initial cultures after 4 to 7 days' incubation may exhibit a slight diffusion of turbidity into the uppermost portion of the media. After prolonged incubation a fine, powdery precipitate forms and slowly settles to the bottom about the tissue fragments. In old cultures the upper column of fluid may become clear again.

Subcultures are made by transferring from 0.3 to 0.5 cubic centimeters of the original culture pipetted from the bottom of the tube in close proximity to the tissue fragments into the next series of tubes. The initial changes in subculture generations are always more marked and the turbidity in the tissue zone exhibits a distinct tendency to rapid diffusion upward rendering the clear medium slightly turbid. Apparently this is but an expression of the gradual accommodation of the micro-organism to cultivation under artificial conditions.

Pure cultures of the minute micro-organism obtained from mouse carcinoma tissue present uniform morphological and cultural characteristics. Stained smears of the fluid from the bottom of the test tube after 5 to 7 days' incubation reveal many definite minute coccal and ovoid bodies arranged in pairs, short chains, and clumps. The organism stains best by Gram's stain or Giemsa stain. It is non-motile and not encapsulated. The minute bodies in young cultures are Gram positive, retaining the gentian violet dye. Other stains such as Loeffler's alkaline methylene blue, carbol gentian violet or carbol fuchsin all stain the organism without giving a sharp differentiation due largely to the intensive staining of the surrounding field.

The minute coccal bodies apparently develop within the carcinoma cells. Films prepared from the lower level of the tubes after previous maceration of the cancer tissue reveal numerous pairs and single bodies within the cancer cells—frequently as many as five to fifteen minute Gram positive organisms appearing within an isolated nest of carcinoma cells.

When stained by Giemsa solution the micro-organism appears considerably smaller than with the Gram stain. The purplish bodies vary in size depending on the age of the culture and the constituents of the media. Minute bodies averaging 0.1 to 0.3 of a micron in diameter predominate in early cultures. In old cultures or occasionally when the sample of ascitic fluid is unfavorable, larger forms appear in cultures approximating the staphylococcus in size. An intensive study of the morphology of this organism in many young and old cultures has shown that the micrococcus is extremely pleomorphic. Furthermore, there is evidence to support the view that the relative variation in the size of the coccal bodies depends largely on the varying degree of oxygen tension. In initial cultures in the tissue ascitic fluid, the small forms always predominate although a considerable variation in size may exist in the same culture tube. The larger bodies may represent degeneration or involution forms at the end of



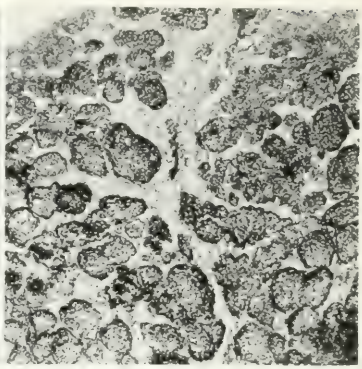


Fig. 1 (at left). Crocker mouse carcinoma No. 11 produced by inoculation of cancer tissue into the subcutaneous and breast tissues of a white mouse. (Low power magnification.)

Fig. 2. Mouse tumor 30 days after inoculation of pure culture of the micro-organism in the second subculture generation. Mouse No. 230. (Low power magnification.)

the life cycle of the organism. The smaller forms, many of them presumably submicroscopic in size, represent the micro-organism as it exists in the cancer cells in a pathogenic form.

Certain it is that subcultivation under partial anaerobiosis always effects a gradual diminution in the size of the coccal bodies until in cultures farther removed from the original growth many of the organisms come to retain the Gram stain with varying degrees of intensity.

Although an initial growth of the organism has never been obtained on solid media, it is usually possible to obtain a growth on solid cultural media after it is once established in the tissue ascitic fluid. In contrast with some of the filtrable viruses the micro-organism associated with mouse carcinoma may be readily subcultured from the tissue ascitic fluid under partial anaerobic conditions on to solid cultural media with free access of oxygen. It grows well on a medium composed of three parts of ascitic fluid plus one part of 2 per cent nutrient agar to which a fragment of sterile rabbit kidney has been added. After 3 to 5 days' incubation a cloudiness appears about the tissue fragment at the bottom of the tube and minute grayish colonies appear barely visible to the naked eye.

Subcultures on standard human blood agar plates appear as grayish white, pinpoint sized, colonies. Streak cultures on the same media exhibit an elevated, luxuriant grayish white growth not unlike cultures of the staphylococcus albus. After 24 to 72 hours' incubation a definite wide zone of hæmolysis is established along the line of growth.

From 14 different mouse tumors all produced by inoculations of cancer tissue emulsion or grafts in the usual manner, pure cultures of the micro-organism were obtained in eleven instances. The organism was isolated from one mouse tumor in association with staphylococcus pyogenes aureus and from a second mouse tumor the organism was cultured together with bacillus coli as a contamination. Of the eleven pure cultures, nine were isolated from early subcutaneous tumors varying in size from a hazelnut to a walnut. One pure culture was obtained from a carcinoma of the liver the size of a cherry. Still another pure culture was obtained from tumor growths present in the peritoneal cavity of a mouse receiving an intraperitoneal injection of tumor cell emulsion 40 days previously.

Subculture generations of the eleven different strains of the organism were inoculated into various culture media. On sugar broth none of the eleven strains attacked dex-

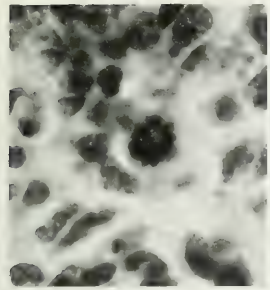


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3. Section of mouse tumor No. 250, showing type of cells and one central mitotic figure. (X1000.)

Fig. 4. First generation culture 16 days old of organism associated with mouse carcinoma. Giemsa stain. (X1000.)

Fig. 5. Seventh generation culture of the organism which has been isolated from mouse cancer tissue. Note that the organisms appear larger with Gram's stain. (X1000.)

trose, lævulose, or mannite. Two strains fermented salicin, raffinose, lactose and saccarhose. Four different cultures fermented inulin.

The organism multiplied in litmus milk without altering the appearance of the medium except in two instances where coagulation of the medium resulted.

Stab inoculations of gelatin with the eleven strains incubated at room temperature for 2 weeks gave varying degrees of liquefaction usually appearing after 3 to 7 days' growth as shallow crater-like zones of fluidification limited to the top of the stab.

Dextrose broth proved to be a favorable cultural medium in which a luxuriant growth developed with turbidity of the broth and the formation of a coarse, granular precipitate rapidly sedimenting to the bottom of the test tube.

When cultures of the organism are grown aerobically on solid media the organism appears considerably larger than in anaerobic cultures. In the tissue ascitic fluid media under paraffin oil, the organism is filtrable. It passes through Berkefeld and Mandler filters tested simultaneously against bacillus prodigiosus. The clear filtrate from subculture generations in the tissue ascitic fluid has in four out of five experiments yielded pure cultures of the minute organisms upon reinoculation into tissue ascitic media overlaid with paraffin oil. Under these conditions growth is slow and appears after 5 to 8 days' incubation as an opalescent zone about the kidney fragment in the bottom of the tubes. Solid media inoculated with the same filtrate under aerobic conditions has never yielded a growth.

### EXPERIMENTAL INOCULATION OF MICE

The minute micrococcus described above is present so constantly in the cancer tissue of inoculated mice as to suggest that this micro-organism might possibly play some important rôle in the riotous overgrowth and lawless proliferation of the carcinoma cells. Whatever may ultimately be shown to be the significance of the organism, the important question at hand is whether or not cultures of the micro-organism are capable of reproducing new tumors when inoculated into mice.

Before recording the several successful inoculation experiments, it seems desirable to discuss briefly certain important points. It is known that tumor tissue rapidly loses virulence when exposed to room temperature for periods of several hours. We have repeatedly observed complete loss of virulence after exposure of cancer tissue or emulsion of tumor cells to incubator temperature for periods of 12 to 24 hours. Repeated filtering of a saline

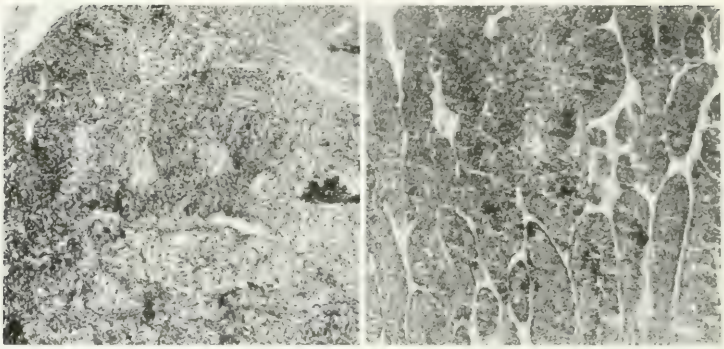


Fig. 6 at left. Mouse carcinoma 40 days old resulting from inoculation of an emulsion of cancer cells plus culture of the micro-organism. Note change in histological structure of the tumor. (Low magnification.)

Fig. 7. A rapidly growing mouse carcinoma resulting from injection of the micro-organism into and adjacent to a well established graft carcinoma. Tumor 20 day's old in second transplantation.

emulsion of the tumor cells through filter paper results in complete loss of virulence. Exposure to a temperature of 50° C. in the water bath completely destroys virulence in 5 to 10 minutes.

Jensen was able to reproduce new tumors in mice after preservation of the sterile tumor tissue in the icebox for 18 days. And Ehrlich was able to reproduce new tumors in mice by inoculation of the sterile tumor tissue after preservation for 1 year in the icebox.

Since incubation of carcinoma cells or exposure to room temperature for relatively short periods of time occasions rapid or complete loss of virulence, we must assume that either the cells die or an organism associated with the cells loses rapidly in virulence or that both factors are in part responsible. Accordingly we were prepared to encounter difficulties in producing tumors with pure cultures of the organism isolated from the cells. Inoculations of cultures into many mice have resulted in the formation of tumors growing to the size of a pea or larger and slowly regressing in large percentage of animals injected. Especially is this true with cultures farther removed from the original source than the second or third subculture generation. Hence it follows that the multiplication of the organism under artificial conditions results in a rapid loss of virulence.

In order to get the tumor to its maximal degree of virulence or adaptation, a heavy sterile saline emulsion of tumor tissue was inoculated into a series of mice. Portions of these tumors were removed sterilely under ether anæsthesia and the remaining tumor cells traumatized. The skin incisions were closed with continuous silk sutures. A rapid recurrence of the growth resulted. The tumors operated upon eventually reached a size equal to half the body weight of the animal, spreading by infiltration from the abdomen and groin up over the back and on to the neck of the mouse. The same operative procedure was repeated in a second series of mice inoculated with tumor emulsion prepared from the preceding animals. All of the mice inoculated were obtained from the same dealer and were of the same stock.

The mice of the second generation passage were etherized when the tumors measured 1 to 2 centimeters in diameter. Pieces of this tumor tissue were removed aseptically and inoculated into ascitic tissue fluid media overlaid with paraffin oil. After 5 days subcultures were made and four mice of the same stock received multiple inoculations of the

organism into the groins and axillæ. The protocols follow:

*Experiment 1. March 3, 1921. 5:00 p. m.* (*Mouse No. 250*). Four mice received subcutaneous inoculations in the groin and axilla of the second subculture generation of the micro-organism.

March 10: Tumors were present in all four mice; the smallest was the size of a BB shot and the largest was equal in size to a split pea.

March 14: In two of the mice the tumor nodules had completely retrogressed. In a large pregnant female (Mouse No. 250) a pea-size nodule was palpable in the right groin.

March 18: The above tumor had grown to the size of a cherry. The animal had given birth to five mice.

March 22: A second pea-size tumor was palpable in the left axilla.

March 30: The mouse had three rapidly growing tumors, one in each groin and a third in the right axilla at all three points of inoculation of the culture.

April 2: The first tumor had grown to the size of a walnut and completely raised the animal's hind leg off the floor of the cage. Animal etherized and photographed. Cultures of the tumor tissue yielded pure growths of the original micro-organism injected. Microscopic sections prepared from these three tumors reveal typical alveolar carcinoma identical histologically with the original carcinoma.

*Control inoculation A, March 3, 1921, 5:30 p. m.* Fragments of the same tumor tissue from which the previous culture was obtained were inoculated into tubes of ascitic fluid under aerobic conditions. After incubation at 35° C. for periods of 24, 48 and 72 hours, three series of normal mice received multiple injections of a heavy saline emulsion of the incubated tumor tissue. The first three mice were inoculated after 24 hours' incubation of the tumor tissue; the second batch after 48 hours, and the last lot of three mice received the emulsion of cancer cells after 3 days' incubation in sterile ascitic fluid. In none of the inoculated mice did tumors appear during 6 weeks' observation.

*Control inoculation B, March 3, 1921, 5:30 p. m.* Two normal adult mice received inoculations with fresh saline emulsion of tumor cells from the same tumor used in Experiment 1 and developed rapidly growing cancers which caused the death of the mice 5 and 6 weeks respectively after the inoculations.

From the control experiments it will be noted that incubation of the fresh tumor tissue for periods of 24, 48, and 72 hours resulted in a complete loss of virulence since no tumors developed in the inoculated mice. That the tumor tissue in the fresh state was active is shown by the rapid growth in the last two mice of this series.

*Experiment 2, April 2, 1921, 4:00 p. m.* Twelve young, white mice were inoculated subcutaneously in the groins and axillæ with a saline emulsion prepared from the tumor tissue of mouse No. 250.

April 9, 1921: Two mice of the above lot had palpable tumor nodules the size of a BB shot.

April 19th: Eight of the ten mice living had developed one or more palpable tumors. The largest tumor measured 1.5 centimeters in its opposite dimensions. The smallest tumor was the size of a pea. One mouse had four different tumors.

April 25th: One mouse found dead in cage with a tumor in each groin. The largest nodule had a maximum diameter of 2.5 centimeters. Sections prepared from this tumor reveal a histological structure identical in appearance with the original Crocker carcinoma No. 11. Cultures from several tumors gave pure growths of the micro-organism originally injected into mouse No. 250 in Experiment 1 above.

From the experiments detailed above it is obvious that injections of the micro-organism in the second subculture generation produced three tumors in mouse No. 250. As further proof that these tumors were genuine mouse carcinomata, inoculations of this tumor tissue emulsion yielded 80 per cent of tumors in experiment No. 2. Cultures of the latter yielded pure growths of the organism originally injected into mouse No. 250.

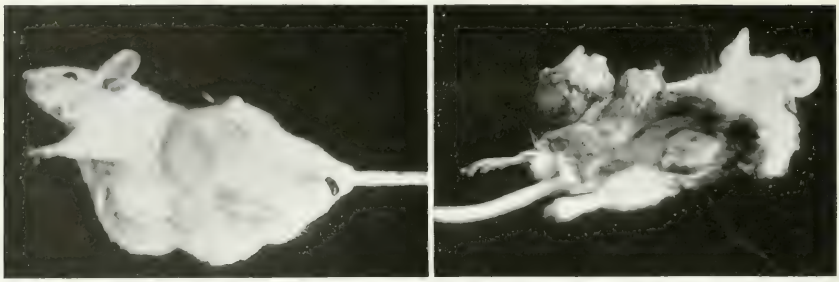
To determine how long a time cultures of the organism retained virulence sufficient to reproduce progressively growing tumors in mice, the following experiment was made:

*Experiment 3, March 19, 1921, 12:00 noon.* Four mice received multiple subcutaneous injections of a 16-day-old anaerobic culture of the micro-organism in the first generation. Tumors appeared in all three mice and slowly regressed in two. In the third large mouse (gentian mark on back) pea sized tumors were palpable in each groin March 28. These nodules enlarged slowly.

April 6th: The mouse was killed and microscopic sections were prepared from the largest tumor nodule. Typical nests and columns of epithelial cells surrounded by a scanty connective tissue stroma.

This observation suggests that the micro-organism after a period of incubation of but 16 days in the tissue ascitic fluid media retained sufficient virulence to reproduce a slowly growing tumor the size of a pea 18 days after injection into the mouse. The low percentage of takes (25 per cent) might indicate that the micro-organism had lost largely in virulence although in the original first generation culture.

An attempt was made to determine the effect of inoculation of a mixture of fresh can-



Figs. 8 and 9. Mouse No. 250. Three tumors resulting from inoculation of the second subculture generation of the organism.

cer cell emulsion plus equal parts of a culture of the micro-organism. Inoculations were made into three series of mice as follows:

*Experiment 4, January 6, 1921, Series A.* Five mice were inoculated subcutaneously with a mixture consisting of equal parts of fresh cancer cell emulsion and a 2 months' old culture of the micro-coccus isolated previously from tumor tissue.

January 26: Large tumors in all of the above mice. Largest tumor measured 1 by 2 centimeters in its opposite dimensions.

February 13: Mouse with largest tumor found dead in cage. Large firm tumor measuring 4 by 2.5 centimeters in its opposite dimensions. A tumor nearly half as large as the body of the mouse after 38 days' growth. Many miliary metastases in the liver.

*Series B.* Five mice of same lot inoculated with small fragments of same tumor used above by trocar method.

January 18: All mice developed small tumors but in three animals the grafts had completely regressed.

January 25: Small slowly growing pea-size tumors present in two of the five mice—40 per cent takes.

*Series C.* Five mice of same lot received inoculations of same tumor cell emulsion into groins and axillæ.

January 26: Large tumors in all these animals. Largest growth measured 2 by 1 centimeter in its opposite dimensions.

An analysis of this small series of mice all inoculated with the same tumor tissue at the same time gave a yield of 40 per cent of tumors with trocar inoculations of small fragments of tissue. Emulsions of the tumor tissue in five mice gave 100 per cent takes with rapid growing carcinomata.

Of five mice receiving a mixture of cancer-cell emulsion plus culture of the micro-organism, tumors of rapid growth appeared in 100 per cent. In one animal the growth equalled half the body weight 38 days after inoculation. At autopsy this tumor was of firm consistancy exhibiting no tendency toward ulceration. Many miliary metastases in the liver of the mouse.

An attempt was made to determine the effect of injection of cultures of the organism into and adjacent to tumors produced by inoculation of cell emulsion in the usual manner.

*Experiment 5, February 8, 1921.* A batch of eight mice was inoculated subcutaneously with saline emulsion of cancer tissue.

February 23: Six of these mice had growing tumors. The largest measured 1 centimeter in its opposite dimensions. The mice were divided into two lots as follows:

*Lot A.* Three tumor-bearing mice received injections of the organism isolated from tumor tissue into and adjacent to the tumor nodule.

February 28: The tumors were enlarging rapidly Mouse with largest tumor etherized and the growth was removed aseptically. It was soft, extremely vascular and friable. See photomicrograph. Stained contact smears prepared from this tumor revealed myriads of organisms in and between the cancer cells. Two mice inoculated with an emulsion of this tumor developed extremely rapid growing cancers. The largest measured 2 by 2.5 centimeters sixteen days after inoculation. The smallest growth was hazel nut size.

*Lot B.* Three tumor-bearing mice received injections of an old stock culture of staphylococcus albus into and adjacent to the tumor nodule. The growths remained stationary, slowly softened and ulcerated in two of the mice. The third mouse died 2 days after injection. Inoculations of tissue fragments from one of these soft tumor nodules failed to reproduce tumors in any one of six mice which were under observation for a period of 6 weeks.

Summarizing the experiment above it might be assumed that injections of the organism into and adjacent to well established, active, growing carcinomata result in an increased rapidity of growth. A detailed investigation of this point might profitably form the subject of a separate paper.

Injections of staphylococcus albus resulted in an apparent retardation of tumor growth with early necrosis and ulceration. Fragments of the tumor tissue so contaminated failed to reproduce new tumors on subsequent inoculation into six normal mice.

## DISCUSSION

The writer has made an intensive study of a transplantable carcinoma of the white mouse known as the Crocker carcinoma No. 11. This investigation has extended over a period of more than 2 years, involving several hundred cultivation experiments with cancer tissue in the special tissue ascitic fluid media. More than twelve hundred white mice were inoculated with cultures and tumor tissue. The investigation has been entirely limited to the same mouse tumor received on four different occasions from the Crocker Research Fund through the kindness of Dr. F. C. Wood.

Employing the special tissue ascitic fluid media under partial anaerobic conditions, a minute, filtrable, Gram positive micrococcus has been isolated quite constantly from emulsions or pieces of carcinoma tissue removed under sterile precautions. The minute coccal bodies present some difficulty in isolation in the original cultures but transfers to subculture generations gradually effect a more rapid and luxuriant growth once the organism becomes adapted to artificial cultivation. It has been carried to the twelfth subculture generation under anaerobic conditions. The minute micro-organism has been seen in stained sections of early carcinoma produced by trocar inoculation of tissue grafts in the usual manner. It has been frequently demonstrated in contact smears of carcinoma cells stained by Gram's method. It has never been encountered in the many control tubes of culture media incubated simultaneously with the cultures.

The organism is present so constantly in this transplantable carcinoma of the mouse that one may or may not be justified in assuming that it plays some important rôle in the propagation of this tumor. One might assume that the minute coccal bodies invade the cancer cell and are carried along with them, acting possibly as a continual irritant to the cell nuclei resulting in limitless division and multiplication. If this assumption is correct we must conceive of two factors or agents responsible for the growth of this mouse tumor, the cancer cell itself and the minute micro-organism present within the cells.

Injections of pure cultures of the organism subcutaneously in the breast tissues of mice have in many instances reproduced tumor nodules which grow progressively for periods of 10 to 30 days and slowly regress in the majority of cases. Microscopic sections of such tumor nodules removed at 24 hour periods reveal a mass of newly formed tissue cells rapidly dividing and supported by a newly formed stroma which becomes vascularized.

By stimulating the tumor cells to their maximal degree of virulence either by incomplete surgical removal with recurrence of the tumor followed by rapid passage through a series of mice of the same stock or, by injecting cultures of the organism into growing tumors followed by transplantation, a method has been found whereby pure cultures of the organism have reproduced new-growths.

Subcutaneous injections of anaerobic culture of the minute organism under these favorable experimental conditions, designed to exclude the probability of carrying over living cancer cells, have in several isolated instances led to the production of tumors which grew steadily producing cachexia of the mouse. Histological studies have shown that these tumors do not vary in structure from the original growth known as the Crocker carcinoma No. 11. Transplants from the tumor growths produced by injections of the organism have yielded similar growths in 80 per cent of a series of inoculated mice. The organism has been readily recovered from these experimental tumors.

Inoculation of cultures into and adjacent to tumors appear to stimulate the growth and enhance the virulence of the tumor tissue in subsequent transplantation.

In contrast to these observations, control injections of a limited number of cultures of staphylococcus aureus and albus, bacillus prodigiosus, and streptococcus hæmolyticus into normal mice have never in the author's experience reproduced tumor growths, abscess formation or septicæmia being the usual result.

Furthermore, when active cancer cells are mixed with cultures of ordinary bacteria, inoculations in mice usually fail to give a "take."

Finally, it should be clearly stated that the author makes no claim of having discovered the cause of cancer. The association of the minute micro-organism with the cancer cells of the transplantable mouse carcinoma suggests that further careful study be made of this organism. While it is theoretically possible that living cancer cells may have been carried along in subcultures, the observations recorded suggest that two agents may be concerned in the etiology of this mouse carcinoma; the first agent being the minute coccal bodies stimulating the cells to rapid division, and second, the cancer cell itself closely associated with the organism and transmitting it from host to host in subsequent transplantations.

The difficulty of reproducing new carcinoma by inoculations of the organism into normal mice might find its parallel in the same difficulties observed in attempting to establish spontaneous tumors of the mouse in other normal mice.

Experimental observations have shown that many spontaneous mouse tumors cannot be transplanted into normal mice. With other spontaneous tumors when inoculated into a large number of mice, commonly only 2 or 3 per cent of the original grafts survive. It is logical to presume that the same difficulties might exist in attempting to establish new tumors by injections of pure cultures of the organism into normal mice. In only three of a series of 89 normal mice so inoculated with cultures has the writer been able to establish progressively growing tumors which on removal presented the typical histological structure of the original mouse carcinoma and were transplantable into other mice. Possibly, repeated injections of cultures over a considerable period of time might serve to increase the number of successful takes. The degree of natural immunity or resistance of the normal host to cancer implantation offers factors far too subtile for explanation at this time.

Recently the writer had under his care a patient with an early carcinoma of the breast. The patient had noted the presence of a walnut sized tumor in the upper, outer quadrant of her breast present for the past 4 months. A radical amputation was performed. The carcinoma nodule was cut into pieces and cultured in the ascitic fluid tissue media. In each of four tubes so inoculated a pure culture of an organism presenting the same cultural and morphological characteristics was isolated. Since this observation the same organism has been cultured from the ascitic fluid of a carcinomatosis of the peritoneum, from a metastatic carcinoma nodule of the omentum secondary to a primary growth in the sigmoid and from a second human breast cancer. The cultural characteristics are identical with those of the organism isolated from the mouse carcinomata. An intensive bacteriological study is being made of the large number of cancer patients presenting themselves for surgical treatment at the clinic of Dr. A. J. Ochsner at the Augustana Hospital, Chicago.

However, it is of the greatest importance to determine whether or not an organism exists in human cancer similar in its cultural and morphological characteristics to the minute micro-organism found in this transplantable carcinoma of the white mouse.

# THE INCIDENCE OF CARCINOMA IN GASTRO-INTESTINAL DIVERTICULOSIS

## Detailed Report of a Case of Gastric Diverticulosis

By R. R. MELLON, M.Sc., M.D., D.P.H.; N. W. SOBLE, M.D.; S. C. DAVIDSON, M.D.; and W. F. FOWLER, M.D., Rochester, New York
From the Department of Laboratories, Hahnemann Hospital

IT is not our intention to discuss with any degree of completeness the literature of this subject, nor to dwell at length on the clinical side of most of the cases discussed. McGrath (1) and W. J. Mayo (2) in their excellent papers have substantially considered these phases of the subject. The gastric case, however, for reasons which will be obvious, will be presented in full.

Since the organization of the pathological department in this hospital 4 years ago, four cases of diverticulosis have been encountered, one of which was at autopsy. The last mentioned case had undergone an operation for another abdominal condition, at which time the surgeon had noted, in the wall of the sigmoid close to the mesentery, twelve to fifteen pea-sized nodules which he was unable to interpret. These proved to be multiple diverticula filled with fæcal material. This case belongs to the symptomless, incomplete variety of the acquired type of this condition. Of the three other cases, two were located in the sigmoid, where they caused intestinal obstruction; the third was in the stomach and was associated, at least, with very definite symptoms, whether it actually produced them or not.

As regards malignancy, the four cases present a graded series. The multiple diverticula of the case which came to autopsy showed no evidence of carcinoma; the gastric diverticulum showed precancerous lesions; one of the sigmoid cases after thorough search revealed a very early carcinoma, and the other showed a carcinoma far advanced.

The clinical history of the two sigmoid cases was essentially that of intestinal obstruction. The cases were diagnosed pre-operatively as carcinoma of the sigmoid. These two patients were respectively 54 and 69 years of age. The elder died about a year after operation, of what was clinically generalized carcinomatosis. No autopsy could be obtained. The younger is still living and well, more than 2 years after operation. These cases were operated upon by W. Frank Fowler, of the surgical staff of this hospital.

On account of the rarity of the gastric type, and because of other features of interest presented by this case, it seems desirable to report it quite fully. Buschi (3) regards this type as of less common occurrence than diverticulosis in any other portion of the gut. It is of interest that this order of frequency is reversed in some of the lower animals. In the pig, for example, diverticulosis most commonly occurs in the stomach and usually near the cardiac orifice.

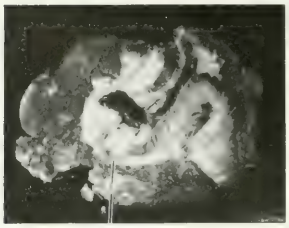
Of the few cases reported, Keith's (4) two were located near the cardiac orifice, while Falconer (5) reports one found in the pyloric end. Carman and Miller (6) report one in which they found evidence of well marked carcinoma in the outer half of the diverticulum. No cases were encountered in the literature where diagnosis was made pre-operatively and verified at operation.

Our patient, C. M. C. of this city, consulted his physician on account of persistent loss in weight. He was referred to one of us (Soble) by Dr. Thomas Jameson and presented himself for examination on September 18, 1919.

The patient's father died at the age of 63 from some form of "splenic" disease; mother and three sisters are living and well. There is no family history of carcinoma or of tuberculosis.

The patient had always previously enjoyed the best of health except for two attacks of bronchopneumonia, from which he had entirely recovered. He denied venereal infection.

*Present illness.* He began to lose weight about 5 months previous to the date on which he presented himself for examination; whereas his best weight had been 168 pounds, he now weighed 137 pounds. His appetite, which had always been of the best, had remained unaffected. He complained of a tired



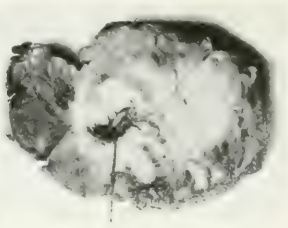




Fig. 1 (at left). Diverticulosis of the sigmoid. Diverticulitis and peridiverticulitis present. Note early carcinoma at *a* invading muscle wall. Note also obliquity and separation of muscle bundles. About three-fourths natural size.

Fig. 2. Same as Figure 1, but printed to show the diverticulum at *a* and the fold of reflected mucosa in its center. Note large mass of fat around periphery of most of the section.

feeling in the morning and recently had worried considerably about his work. He attributed this to the fact that he had not had a vacation since 1918. He complained also of pressure and fullness in the region of the stomach. There was belching, but no nausea or vomiting. He had been occasionally but not chronically constipated. He had suffered no pain.

*Physical examination.* The patient was a well nourished male, 49 years of age, and married. He had been employed in a large machine shop. He appeared in robust health. His pupils were equal and accommodation normal. The only abnormal findings were suspicious looking teeth and a small ulcerated area on the left side of the nasal septum. Examination of the heart and lungs was negative. The abdominal examination was negative and there was no evidence of pain anywhere, even upon pressure. No developmental defects were observed on external observation.

*Blood examination.* Hæmoglobin (Tallquist) was 100 per cent; red blood count 5,100,000; white blood count 10,000. Differential count: polymorphonuclear 73 per cent; large lymphocytes 7 per cent; small lymphocytes 16 per cent; eosinophiles 2 per cent. Blood pressure was 120 systolic and 80 diastolic. The Wassermann reaction on September 27 was negative with both antigens.

*Urinalysis.* The urine was negative.

*Gastric analysis.* Patient had had no breakfast. Upon passing the stomach tube a 20 cubic centimeter residue was obtained, which on analysis gave the following data: color, lemon; odor, offensive; consistency, very thick; reaction to litmus, acid. Free hydrochloric acid was present, but no estimation was made of the amount. There is no report of a test for blood having been made at this time. An examination of Ewald's test meal, withdrawn 50 minutes after ingestion, shows: free hydrochloric acid, 40; total acidity, 60, with a positive blood reaction to the benzidine test. Microscopic examination showed the presence of a few starch granules, a few Boaz-Oppler bacilli and many red blood cells. An examination of the morning residue the following day, for blood, with the benzidine test, gave a positive reaction.

*Roentgenological examination.* Patient was allowed to swallow 16 ounces of fresh buttermilk containing 4 ounces of barium sulphate in suspension. A fluoroscopic examination was made with the patient in the erect position. There was no obstruction to the passage of the meal into the stomach. The stomach itself presented a picture characteristic of the organ in its hypotonic state, but it was normal in size. Its position was to the left of the median line. Moderately active peristaltic action was observed. The outline of the greater curvature showed a T-shaped evagination protruding from the greater curvature at about the junction of the pars cardia with the pars media (Fig. 6). The duodenal cap was visualized directly over the spinal column and seemed regular in outline. There was no evidence of adhesions.

A series of plates taken within 1 hour after the ingestion of the barium meal showed a pouch, apparently regular in outline, extending outward from the greater curvature of the stomach, nearly opposite the cardiac opening and connected with the stomach proper by what appeared to be a narrow isthmus or pedicle.

A diagnosis of diverticulum of the stomach was made; in view of the clinical history of the patient and the chemical and microscopic findings of the gastric contents, early malignancy was suspected. Surgical interference was advised, and on September 26, 1919, Dr. Thomas Jameson removed the section of the stomach to which the diverticulum was attached. At the time of operation, it was observed that the intact mucous lining of the stomach was grayish-white in color and that it separated very easily from the muscular wall.

The resected portion of the stomach measured 5 centimeters in diameter. The diverticulum itself would just admit the thumb and had a depth of

Fig. 3. Cross section of diverticulum. Carcinomatous area in upper left-hand corner. Micro tessar 48 mm. x 10

1.5 centimeters. The neck was somewhat constricted by a thickened ring, due perhaps to a retraction of the muscle bundles which apparently had disappeared from the tip of the evagination. A congested dark area was present over the distal portion of the structure. A thickened, somewhat granular mucosa was intact over the entire surface of the specimen.

Microscopic examination confirmed the macroscopic appearance of mucosal integrity and showed, in addition, a marked superficial, round-celled infiltration, generally and rather diffusely distributed. The gland cells were quite hyperplastic, and the lumen of some was so dilated as to suggest retention cysts. In places the dilatations were engorged with polymorphonuclear cells. The deeper levels of the mucosa of the diverticulum disclosed numerous tubules, the cells and nuclei of which were very hyperchromatic and approached very closely the type of change seen in tubules of Figure 2. The arrangement and morphology of the cells so closely parallels that seen in transition areas of the carcinomatous sigmoid case (Figs. 2 and 3) that we felt justified in designating the lesion as precancerous.

The dark area seen at the distal extremity of the pouch is easily explained microscopically by the marked congestion of the small vessels, and recent extravasation, in addition to an older extravasate in the adjacent muscle bands, which are hæmatoidin stained. It is of note in this area of separation of the muscle bundles that several fairly large vessels were present. The muscle bundles show a separation and direction somewhat comparable with that seen in the sigmoid cases.

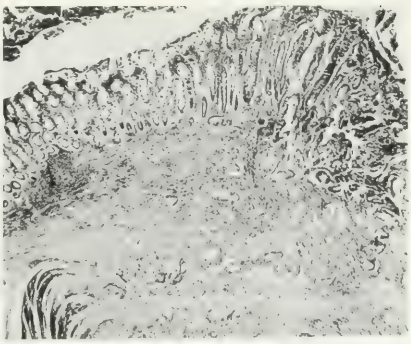


Fig. 4. Normal mucosa at extreme left with progressive increase of atypical tubules merging into carcinomatous area at extreme right of picture. Micro tessar 48 mm. x 25.

Of considerable interest and importance is the probability that carcinoma may begin in the diverticula without ulceration of the mucosa. In one of the sigmoid cases this seemed highly probable, but in the other it seemed rather probable that ulceration had preceded the malignancy, inasmuch as the process was well marked in many areas of the tissue, while the carcinoma was located in one area only.

We shall now proceed to some of the pathological details of one of the sigmoid cases, in which malignancy appeared to begin on a mucosa free from ulceration. The specimen as it came from the operating room was roughly circular in shape, lobulated, fatty, and presented a mottled hæmorrhagic appearance. It measured 8 centimeters long, 5 centimeters wide, and 3.5 centimeters thick. It was only after sectioning the entire tissue and carefully examining each gross section that one with a suspicious area was found. This manifested itself by an interruption in the integrity of the mucosa, which in other places was sharply delineated from the underlying muscle.

The area referred to is seen at *a*, Figure 1, its limiting margin presenting a scalloped appearance where it has become invasive. Careful search of this diverticulum reveals a mucosa practically intact—even where the latter is definitely malignant—with the exception

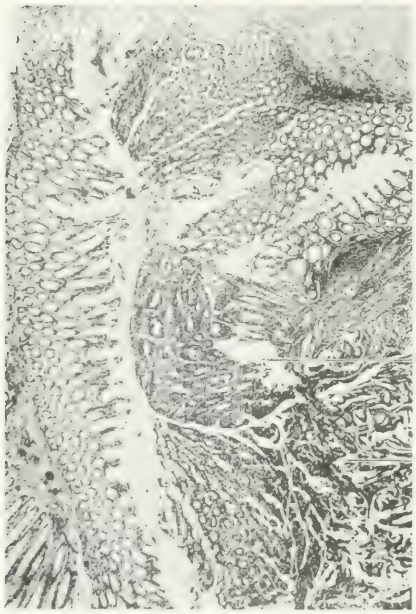


Fig. 5. The vertical lumen of the diverticulum separates normal mucosa at the left from atypical mucosa at *a*, which is definitely invasive at *b*. Micro tessar 48 mm. × 25

of one point, where a superficial ulceration is present. This, however, is of recent occurrence and probably secondary, as is implied by the presence in the slough of portions of the carcinomatous glands.

Figure 4 is of interest as showing the steady increase of atypical tubules from left to right until the definitely carcinomatous area at the extreme right of the picture is seen. The atypical character of the cells was recognized in part by their very hyperchromatic nuclei, noticeable particularly in the lower levels of the affected glands. This abnormality, however, does not respect even the superficial portion of the tubules as the carcinomatous portion of the tissue is approached. The contrast between normal and carcinomatous tubules is further shown in Figure 5. At point *a* this very atypical mucosa with the hyperchromatic cells is continuous with the adjacent area, *b*, which is still more hyperchromatic; in fact the latter is definitely carcinomatous and is in part identical with the invasive area, as seen in Figure 1 at *a*. The left side of Figure 5 shows a perfectly normal mucosa. It is to be observed that all the mucous surfaces of Figures 4 and 5 are not ulcerated.

A well-marked, round-celled infiltration is present throughout the diverticulum, being particularly well marked in the atypical portions. It is also present beyond the muscle walls, in some granulomatous tissue—peridiverticulitis. In Figure 1 the angulation of the muscle walls, together with the obliquity and abnormally separated muscle bundles, is conspicuous. It is of note that all layers of the gut participated in the angulation process, but the mural layers, although everywhere present, did not always follow the tortuosities of the mucosa. The spaces enclosed by the sinuosities of the latter were usually shown to have definite connection with the lumen of the intestine.

## DISCUSSION

McGrath speaks of two general classes of diverticula: (1) the congenital, and (2) the acquired. The prototype of the former is exemplified by Meckel's diverticulum, which is recognized as a developmental defect. McGrath says further that it has been suggested that certain of the acquired variety are in a certain sense congenital. Buschi (*loc. cit.*) in his analysis, is also a strong exponent of their congenital origin.

It is, indeed, difficult to explain satisfactorily the pathogenesis of this condition if we leave out of consideration entirely, congenital structural defects. True it is, the literature affords us a galaxy of supposed etiological factors, from which it would seem that the most fastidious might extract a combination adequate for each and every case; but, short of an unusual concatenation of circumstances, it is hard to assign to any of them more than a contributory rôle.

Among the causal factors cited by McGrath are the following: (1) obesity, (2) cachexia

and absence of fat, (3) a previous state of obesity and subsequent wasting, (4) normal structure of the large intestine, (5) physiological rôle of the sigmoid flexure, (6) intra-intestinal pressure, and (7) muscular deficiency of the intestinal wall.

Of the acquired diverticula, two types have been recognized: (1) the incomplete, which involves all the intestinal layers except the muscular. This, the most common form, is also spoken of as "hernia mucosæ" inasmuch as it is essentially an evagination of the mucosa through a "locus resistentiæ minoris." The other variety of the acquired type involves all the layers of the intestinal wall and is exemplified in the two sigmoid cases. The gastric case is of the incomplete variety.

The point which we wish to stress is the apparent predilection of this condition for the development of carcinoma. From the clinical standpoint, this is one of the soundest arguments for its early apprehension and proper treatment. Of a total of 27 sigmoid cases, McGrath records 7 of carcinoma (25.9 per cent) but states that "all of these cases were of advanced peridiverticulitis" which should be distinguished from the incidental, symptomless variety encountered at autopsy. Inclusion of such cases would, of course, lower the percentage materially and give a false conception of the frequency of malignancy where the condition is clinically significant.

In explanation of the frequency of malignant transformation in these cases, it is noteworthy that an apparently significant combination of contributory causes is here present. In support of the theory that "tissue tension alteration" is an important factor in neoplastic initiation, it would appear that in diverticulosis we have an example *par excellence*.

In the "complete" type of this condition, the labyrinthine windings of the mucosa, together with the obliquity and consequent separation of the muscle bundles, bear testimony to the interstitial strains that must be the resultant of these processes. And in a mucosal hernia as it exists in a viscus, more or less constantly contractile, interstitial strain must again be unavoidably associated with the histopathological changes in evidence, viz., passive congestion, hæmorrhage, and dilatation of the incarcerated gland structures.

Fig. 6. Roentgenogram of stomach with gastric diverticulum at *a*. Reduced to about one-third original size.

Nutritional disturbances are the logical sequel of this mechanical stress, which in their turn invite infection, a factor of neoplastic importance. It was of note that the Boaz-Oppler bacillus was present in the gastric case, although no definite carcinoma could be demonstrated. Accepting the fact that this organism is frequently associated with gastric cancer, its presence is entirely congruous with the assembled evidence. It would seem, then, that a high percentage of cancer might well eventuate under conditions so favorable for the interplay of two factors the appraisal of which, in a neoplastic sense, has always been so high.

## CONCLUSIONS

Gastro-intestinal diverticulosis is an important abdominal condition which does not have the recognition from the abdominal surgeon that it deserves. The gastric cases are the rarest. The one here reported was diagnosed pre-operatively by means of the X-ray, and confirmed by pathological examination.

The conditions prevailing in these curious formations seem to facilitate the development of carcinoma, which fact makes their early recognition and removal a matter of first importance to the patient. Ulceration is not a necessary condition for the development of carcinoma.

Whether carcinoma develops or not, diverticula are always a source of danger to the patient, owing to the sequelæ of infection and obstruction.

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## RANULA OF BRANCHIAL ORIGIN[1]

By LOUIS CARP, M.D., New York
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IN confirmation of some recent contributions to the subject of ranula by Skillern, Lewis, and Thompson, the following is offered as an analogous case.

A. J., 20, Austrian, housewife, first consulted me about the middle of July, 1920, with a visible swelling in the left cervical region and a swelling under tongue, both of which she had had for 3 weeks. Her family and past history were irrelevant. In January, 1920, she noticed a small swelling to the left of the under surface of the tongue, which gradually increased in size and was slightly painful. In about 10 days she also developed a swelling in the left submaxillary and cervical regions, which also gradually increased in size until both swellings caused her difficulty in talking and deglutition. These were slightly painful and tender, because of which reasons she consulted a surgeon, who, 3 weeks after the inception of her illness (January 28), under a general anæsthetic, "excised" the swelling under the tongue. The swelling in the neck disappeared and the patient was well for 2 weeks, when she had a second operation in the mouth (February 14) for a recurrence of the swelling. Thereafter, she was well for 3 weeks, but then began to drain a mucinous fluid through the mouth until the onset of her present illness. For about 3 weeks she had the initial gradual increase in size of the swelling of the neck and under the tongue. The general physical examination was negative, except that she was very nervous, rather pale, and had several bad teeth. The urine and Wassermann were negative. Local examination revealed a typical ranula to the left of the frenum of the tongue about the size of a walnut, which was very tender. In the left submaxillary and upper cervical regions there was a semi-elastic, fluctuating swelling which was very tender, not attached to the skin, and not movable on the deeper parts. Pressure over it caused a slight increase in size of the ranula and the production of a transmitted fluid wave. We then apparently had to deal with a ranula which communicated with a cyst in the neck.

Operation, July 14, 1920. The patient would not take a general anæsthetic, so, under local 2 per cent novocaine anæsthesia, the ranula was excised. At the floor of the mouth, to the left of the frenum, there was seen a small sinus which admitted a fine silver probe. By pressing on the cervical swelling, there could be expressed through this opening about 8 ounces of brownish, thick, mucinous material. Insertion of a probe through the opening carried it posteriorly about 4 inches and almost to the parotid region. Under these manœuvers the swelling in the neck collapsed to a level with the skin. The patient obtained almost immediate relief, but in 2 days returned with a recurrence of the swelling in the neck. Examination revealed that the communicating sinus had closed and that the cervical cyst completely filled the submaxillary triangle and was very tender.

Operation, July 16, 1920. Under local anæsthesia a 3.5-inch incision was made parallel to the left mandible, and about 1 inch beneath it. The platysma was incised, the submaxillary gland retracted, and there was exposed the cyst wall. It was very thin, looked just like a "frog's belly," and was intimately adherent to the surrounding structures. With a very nervous patient, no very extensive dissection of the cyst wall could be made. About as much as would cover a silver dollar was removed with the efflux of a large quantity of the same brownish mucinous material which we had encountered previously. Insertion of the probe could only be made in two directions; one, the submaxillary region, and the other, in the direction of the parotid

[1] Presented at the Metropolitan Medical Society, New York, November [illegible]

region. It was clear that an obliteration of the cyst cavity would have to be attempted by the introduction of irritants. Accordingly, the cyst lining was swabbed with pure carbolic acid and immediately followed by swabbing with alcohol. A packing, impregnated with a mixture of iodine, carbolic, glycerine, and water was introduced into the two cavities; one the submaxillary, and the other, the upper cervical. The skin was closed with interrupted sutures. For 10 days the cavities were repacked daily, and at the end of that time granulation was complete and the wound was firmly healed. During the first 6 days, there was profuse drainage of cyst content. The patient was free from all pain. Examination 5 months later showed no recurrence of either the ranula or the cervical cyst.

This type of case was not reported until a very able article by Thompson of Galveston, Texas, in the same month that this case was operated on by me. In it he attempts to discard the theories that a ranula comes from the sublingual gland, one of the mucous glands at the floor of the mouth, Wharton's duct, or the "adventitious bursa of Fleischmann." He attempts to prove that such an anatomical defect probably is derived from the so-called cervical or precervical sinus, which comes about through non obliteration of the second and third branchial clefts by the folding down of the second branchial arch. Under ordinary conditions, such a cyst would be low down in the neck, but due to a migration upward of the muscles of the tongue derived from the hypoglossal and palatal group, the cyst assumes a high position. Thompson has had experience with several cases. Two other cases are reported, one by Robert M. Lewis, and the other by P. G. Skillern, Jr. These are almost the exact analogues of mine. They, however, are of the opinion that the origin of the ranula and the cyst is in the sublingual gland. In a previous operation for ranula, Skillern's case had the submaxillary gland removed. Wherefore, he comes to his conclusion by a process of elimination.

The pathology is a moot point; Skillern gives no report of a microscopic examination. Lewis found that "the cyst wall showed a very thin outer coat of fibrous tissue lined with a simple layer of flattened epithelial cells." Thompson reports that "microscopic examination of the lining membrane of the cyst wall has been rather unsatisfactory. In most cases we were unable to find epithelium. When present it was of the tesselated variety. The fibrous tissue was fairly dense and the fibrous bundles were separated by large lymph spaces containing very few cellular elements."

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# DEPARTMENT OF TECHNIQUE

## CONTROL OF CHRONIC PAIN[1]

By FREDERICK DYAS, M.D., F.A.C.S., Chicago

CURRENT medical journals are full of accounts of operations designed to restore the lagging functions of youth and are read with avidity by both the medical profession and the laity. Possibly the reaction from the destructive processes of war has stimulated an effort upon the part of the writers to conserve life to the uttermost and to make procreation, even by the senile and by the abnormal, the great aim of the investigator.

While these attempts to stretch the span of life beyond the allotted three score years and ten and to restore the waning power of the sexual glands are worthy of admiration, there are some problems of a nature so practical and so pressing that there is some excuse for directing our energies away from the more alluring search for the fountain of youth. Among these is the urgent need of a method for the accurate and scientific control of chronic pain, especially that due to recurrent inoperable malignancy. The intractible pain of tic douloureux stimulated attempts to give relief to the sufferers by a method less hazardous than the surgical removal of the gasserian ganglion, which had an operative mortality of 50 per cent in the hands of the most experienced operators. To this end avulsion of the ends of the branches of the trifacial nerve, as far as possible beyond their foramina of exit, was practiced with temporary relief. This plan was succeeded by the injection of the nerve trunks by 2 per cent osmic acid. Relief was obtained by this plan for varying periods, but it had the disadvantage of being extremely irritating to the surrounding tissues and frequently caused necrosis when the injection was not accurately made into the nerve sheath.

Injections of alcohol of varying strength have proved satisfactory in a large number of cases of facial neuralgia and have produced analgesia for periods of 6 to 18 months. Thus the efforts to short circuit the painful area in facial neuralgia constitute the first accuracte, scientific, and safe method of combating chronic pain.

It seemed possible, therefore, to render other areas analgesic in which the paths of pain conduction were accessible to the injecting needle. If it is possible to perform almost any type of operation under local anæsthesia why should it not be just as feasible to render any given field painless for a greater length of time?

While the material at hand did not give an opportunity to test out a great many areas, the results achieved in the cases treated at least justifies a more extended application of the principle, i.e., local anæsthesia for the relief of chronic pain.

As the experimental and clinical data have not been sufficient to render an exhaustive report, this paper is presented rather as a preliminary study than as a comp'ete work. The possibilities of mastering pain in hopeless conditions of malignancy was the incentive under which this work was undertaken. Every surgeon has seen cases of malignancy in which apparently none of the older methods gave relief. The woman with recurrent carcinoma of the breast, rocking constantly to and fro with the pain, is a not uncommon patient in any large hospital. The dread picture is familiar to us all, and yet so far no work has been undertaken for its relief. Many persons have no fear of death, yet who does not dread pain?

In many situations chronic pain may be controlled by interrupting the paths of pain conductions by the methods in vogue in local anæsthesia. The scientific accurate control of pain will do much to rob the course of hopeless malignancy of its horrors. The mental anguish may remain, but the somatic suffering in most cases can be spared to the patient. The relief of constant pain revives the drooping spirits of the sufferer and enables him often to put on weight and to gain in strength. The time-honored but inefficient attempts to produce an euthanasia by the administration of ever-increasing doses of opium or other narcotics must give place to a procedure which is efficient and which preserves the individual as himself to the end.

[1] Read before the Chicago Surgical Society, March 4, 1921. (For discussion see page 206)

The short circuiting of the painful area is accomplished by nerve-blocking in the form of neurectomy or of intraneural injection. In relatively small superficial malignant lesions the same end may be accomplished by the healing of the ulcer by radium. This is especially true of lesions about the orifices of the body. Nerve-block relieves the pain during the period of healing.

The agents used for intraneural injection are numerous and it is probable that no single drug is suitable to all cases. Chronic pain due to some condition other than malignancy is perhaps best treated by salt solution, novocaine, apothesin, or quinine and urea, because these produce but temporary loss of pain conduction. In painful states due to malignancy in which loss of motor function is of little moment, alcohol injections of the nerves or neurectomy is indicated. In cases of recurrent mammary carcinoma with great swelling and œdema of the upper extremity, the patient usually has to carry the involved arm, almost as a foreign body. Pain and swelling are so great that movement is practically impossible. Under such circumstances permanent block of the brachial plexus is indicated either by alcohol injection or by nerve resection. Nerve-block of the posterior sensory spinal nerve roots or intercostal nerves is frequently necessary as an adjunct to brachial plexus block because of metastasis in the tissues of the chest.

In thorax operations injection of intercostal nerves is best done at the lateral margin of the erector spinæ muscles near the angle of the ribs rather than close to the spinal column. On account of the many injections necessary when all the intercostal nerves are blocked it is better to mark out the points of attack first and these are later connected by a line of infiltration reaching from the first to the twelfth rib. The patient is in a sitting position with the spine flexed and the shoulder on the affected side carried forward. The nerve-block is now done by introducing the hollow needle just inside the infiltrated area about on a level with the spinous process of the first dorsal vertebra. The point is carried downward until the resistance caused by its contact with the first rib is felt. The under border of the rib is now sought and as soon as the point meets no more bony resistance the needle is forced in for the distance of one-half centimeter further and 5 cubic centimeters of solution injected. The same procedure is carried out in the second rib and so on until the desired area has been blocked off. After 15 minutes there is analgesia of the ribs, muscles, and pleura from the point of injection posteriorly as far forward as the sternum.

Kuhlenkamp's method of blocking the brachial plexus for the relief of acute and chronic pain in the upper extremity is as follows: The first rib is palpated just above the point where it passes beneath the clavicle. Slightly external to this the pulsation of the subclavian artery may be felt. The hollow needle is introduced just beyond this. If blood appears the needle is carefully withdrawn and introduced more laterally. It is carried downward until the resistance of the first rib is felt or until the patient feels the referred pain in the arm. The syringe is then attached and 5 to 10 cubic centimeters of one-half per cent solution apothesine or novocaine injected. Care should be observed not to use the needle as a lever because of the danger of tearing the subclavian vein. Analgesia appears in about 15 minutes.

It is not necessary with the use of novocaine or apothesin to inject the nerve sheath, although this is desirable because these agents are diffusible while with quinine and urea or alcohol it is necessary to inject the nerve sheath. It is therefore recommended that the plexus be exposed by incision under local anæsthesia when permanent analgesia is required for the relief of pain due to malignancy. With the plexus exposed either alcohol injection of the cords or section should be done.

ILLUSTRATION

Case 1. An emaciated almost moribund French woman of about 60 years with a scirrhous carcinoma of the breast. The primary tumor was about the size of an orange and ulceration of the mass was advanced. There were metastases in the axillary and supraclavicular regions, but there had been no swelling of the arm. Pain had not been a marked symptom in this case because of the slow growth of the scirrhous tumor, but there was a continuous ache and discomfort.

A small cutaneous infiltration was made in the usual way just outside the point at which the calcareous subclavian artery was palpable. This spot lay in a deep fossa behind the clavicle which was elevated in the position of forced inspiration by the emphysematous character of the thorax. The needle was introduced at the point where the first rib passes beneath the clavicle. The patient exclaimed when the needle came in contact with the brachial plexus. Referred pain in the upper extremity is the sign that the needle has reached the desired spot. The syringe was then attached to the needle and 10 cubic centimeters of one-half per cent apothesine or novocaine solution introduced, at which time the needle was carried more deeply into the plexus. After the blocking of the brachial plexus the intercostal nerves of the same side from the second to the tenth rib were infiltrated at about the outer border of the erector spinæ muscles and the points of injection were connected with a perpendicular line of infiltration.

Case 2. This woman was operated upon about 1 year previously and now has a recurrence in the scar and

axilla with brawny infiltration of the skin and elephantiasis of the arm, the tissues of which closely resembled the bark of a tree in color and consistency. This woman complained of great pain in the chest but comparatively little in the arm. Infiltration of the skin was done with great difficulty on account of the induration and the brachial plexus reached as evidenced by the patient's complaint of referred pain in the arm and hand. Ten centimeters of one-half per cent novocaine solution was injected into the plexus. This was the more difficult because the patient was unable to sit up. The intercostal nerves upon the same side from the first to the ninth were blocked in the usual manner.

Case 1 died within 24 hours following the nerve blocking. In this case, however, the fatal termination could not be charged to the novocaine injection as much larger doses have frequently been used without any systemic effect and it is a matter of general experience that 8 to 10 ounces are within the range of safe dosage when used over a large area and in tissues from which the rate of absorption must be slow. Case 2 was free from pain in about 15 minutes after the injection. She had complained of a sense of constriction about the chest before the nerve block but this distressing symptom disappeared, allowing of comfortable respiration. Forty-eight hours later there had been no return of the girdle pain.

Case 3. Sarcoma of the shaft of the humerus in a man of 40. There was enormous swelling of the arm, the soft tissues being tense and shiny. Ulceration had not occurred. The patient was brought into clinic in a wheel chair, rocking his body to and fro and moaning with pain. The brachial plexus was blocked by the method of Kuhlenkamp and within 10 minutes the patient was free from pain. The following day the radical operation with removal of the shoulder girdle and arm was done under general narcosis and the patient left the hospital as soon as his wound had healed so that further observation was impossible.

Case 4. Chronic intractible pain of the upper extremity following hemiplegia. This woman complained of inability to sleep and loss of weight and strength because of the constant pain. The brachial plexus was injected by the method described and the patient had a good rest the following night. Forty-eight hours later she reported that there had been no recurrence of the pain.

From the results obtained in the cases above described the belief is held that much of the suffering endured in the past may be avoided and the afflicted patient, though perhaps in an inoperable condition, may live out his days in peace.

With the pain gone, sleep becomes possible again, the general condition of the patient improves and death finally supervenes as the result of toxæmia rather than from exhaustion due to pain.

## THE APPLICATION OF SILVER FOIL AS A PREVENTIVE OF PERITONEAL ADHESIONS[1]

By ARTHUR J. PULS, M.D., F.A.C.S., Milwaukee, Wisconsin

### Etiology of Septic Adhesions

Peritoneal adhesions owe their formation either to inflammatory abdominal and pelvic processes or are the sequel of a preceding surgical operation in spite of every aseptic precaution. Although the topic of frequent discussions at medical meetings, the surgeon is still at a loss to prevent this affliction to patients undergoing a primary or secondary cœliotomy.

Prophylaxis, i.e. strict asepsis, combined with rigid observance of the principles of surgery may prevent these complications, provided the patient, at the time of operation, does not suffer from bacteriæmia, in other words, is free from focal infection. The surgeon considers a diabetic or pyæmic patient a poor risk for immediate operation, but often overlooks one, who, apparently in good health, has hidden somewhere in the system a purulent gland or an infected sinus. It is obvious that he creates a *locus minoris resistentiæ* at the site of the operation field, even though he securely sutures the incised peritoneum. No matter how fine the needle, the puncture allows of secretion of minute driblets of blood and serum containing pyogenic germs and these cause a local inflammation, which produces web-like tissue formations between neighboring organs. How can we otherwise explain the repetition of the formation of adhesions after a thorough removal of the membranes? The introduction of a chemical irritant such as tincture of iodine and bichloride of mercury on the peritoneum, may cause abrasion of the epithelial cells and subsequent inflammation. We are supposed to practice asepsis but still resort to antiseptics in order to sterilize the patient's skin and the surgeon's hands, but contamination from those drugs of the abdominal organs must be avoided. Most of the peritoneal adhesions which the gynecologist is apt to deal with are caused by, first, sepsis of the uterine organs incidental to abortion or labor through direct external infection; next venereal infections, gonorrhœa, and lues, and then tuber-

[1] Read before the Chicago Gynecological Society, February 18, 1924.

culosis and carcinomatosis of the abdominal organs. Furthermore, ectopic gestation, acute and chronic appendicitis, cholecystitis, a perforating ulcer within the intestinal tract and finally a foreign body within the abdomen give rise to peritoneal adhesions.

Of the above mentioned infections which are known to be followed by various kinds of adhesions, the gonococcus is by far the most effective germ, and at the same time, the most destructive in undermining the physiological functions of the female sexual organs. As a curative procedure in gonorrhœal salpingitis, the fallopian tubes and ovaries, which are frequently enveloped in pus abscesses, and the comparatively innocent uterus, on account of its serous attachment to the diseased adnexa, need to be removed in their entirety in order to combat this infection. Conservative measures can only be undertaken after the disease has outrun its course.

### ERA OF ANTISEPSIS 1880–1900

The early abdominal surgeons paid far more attention to the successful issue of the operation than to the formation of adhesions. These they even invited by the use of the rubber or glass drain. The question as to the disadvantages of drainage at wound closure was not raised until the beginning of the nineties. The concensus of opinion was unanimous, "when in doubt, *drain.*" They became cognizant of the after-effects, and that adhesions between the bowels at times caused acute ileus, if not, at least a life-long intestinal distress, but the drain was considered a life-saver in many a case of abdominal operation. Lest we forget, abdominal tumors operated upon by these men were, without exception, of enormous size, adherent to the pelvic floor and abdominal wall, often degenerating into malignancy.

Although 95 per cent or even 100 per cent of his patients survive a capital operation without the use of a drain, the gynecologist of today wants his patients to remain free and be rid of all the discomforts from which they have suffered prior to surgical intervention; he does not intend to add a new affliction which may develop indefinite symptoms, but which a secondary operation reveals to be in the nature of peritoneal adhesions formed between the uterine appendages and a loop of the small intestine.

### ETIOLOGY OF ASEPTIC ADHESIONS

From the foregoing, we have seen that adhesions of the peritoneal covering of the abdominal organs are chiefly the outcome of direct or indirect sepsis, and in contrast shall find that traumatism produces the aseptic type. In the direct septic type, germs have been introduced from without during an abdominal operation, a process, however, which we may exclude as long as strict asepsis is being practiced in a modern hospital. Hence, we shall consider only the indirect septic type, or auto-infection, as the primary cause to which the patient owes the existence of peritoneal adhesions, and later we shall review the aseptic type produced by surgical trauma.

During the acute stage of local peritonitis, adhesions to adjacent organs arise as a protective barrier. The membranes close and wall off an abscess cavity during pus formation, otherwise the patient would succumb to a general peritonitis. Rupture of such a defined acute abscess by whatever cause, calls for immediate surgical interference and drainage of the contaminated cavity.

A study of the anatomy of the lymphatic system, and more so, the knowledge of the relation of the pelvic connective tissue with each pelvic organ is essential, in order to explain the formation of pelvic exudates and of the adhesions which develop in the course of septic pelvic inflammatory disease.

But little has been added to the master work of Mascagni, whose atlas of the lymphatic system of the human body was the forerunner which led to the microscopic studies of the infectious diseases. (Chrobak and Rosthorn, page 175.)

The late work of Alfons von Rosthorn on the connective tissue of the pelvis has contributed much to our understanding of exudate formation and the course which pelvic exudates pursue in order to find an outlet for their pus contents. Following along prescribed routes, pus from a parametral abscess gravitates by way of the round ligaments into the inguinal canal; from the upper part of the broad ligament, it follows the psoas and iliac muscles down to Poupart's ligament. Exudates formed in the anterior pelvic cavity surround the bladder and extend along the anterior lower abdominal wall and travel toward the pelvic brim; those situated posteriorly, pass upward along the spinal column and surround the kidneys. After subsidence of the acute symptoms and during the period of resolution or evacuation of the pus by the surgeon, adhesions of various degrees of density and firmness are met with as the outcome of the preceding inflammatory processes.

Aseptic adhesions are mostly the result of surgical interference. In clean cases, such as in

operations for myomectomy, for malposition of the uterus, for initial appendicitis, or for cystic ovaries where the surgeon finds the entire peritoneal serosa intact and glistening, adhesions frequently do occur and form immediately after closure of the abdomen. What explanation can we offer for this phenomenon?

It is unusual, at the present day, to meet with wound infection, but it does happen to some of us, owing to various trifling causes or careless oversights, mainly due to haste, and such infection ends in the formation of hæmatomata, on account of the suture material being too quickly absorbed, or because of contamination of the wound with the hands of the patient, etc., etc. In vicious cases of wound infection, the infection affects first the fascia, next the muscles down to the peritoneum, so that the outcome, after weeks of suppuration, results in a postoperative hernia with internal adhesions of the peritoneal wall to the omentum or to the intestinal tract, leaving the person operated upon in a condition worse than he was before operation. Besides the surgeon will have on hand a very ungrateful patient. The wise man, in order to remedy the mischief, plicates the fascia, and thus cures the external injury, but leaves the internal membranes alone, lest he multiply their number.

### DIAGNOSIS

It will always remain more or less a matter of conjecture to diagnose from symptoms complained of, even if a bimanual examination of the pelvis discloses malposition of the uterine organs, that the patient's ailment is due to the presence of peritoneal adhesions. Many times in cases of constant suffering from pelvic disease, adhesions are not found, and then again the existence of a mass of membranes between the various abdominal organs causes no pain whatever. The experienced diagnostician may conclude from the previous history of pelvic infection, that peritoneal adhesions will not be found wanting within the pelvic cavity. The severity of pain expressed by the patient is not always a criterion of the actual pathological condition. The gynecologist distinguishes between the hypersensitive and those patients who affect indifference to pain. During ovulation the ovary becomes highly sensitive so that a displacement of the right ovary by an adhesion to the intestine or to the appendix may simulate appendicitis.

As an aid to the diagnosis of intestinal adhesions, we may be able to judge from the fluoroscopic picture should a loop of an intestine be held firmly within the pelvic cavity.

### PROPHYLACTIC TREATMENT

In pelvic as well as in general abdominal surgery, peritoneal adhesions can be prevented by observing the following surgical principles:

1. Never leave raw surfaces devoid of peritoneum, uncovered.

2. Do not allow leakage of the vessels and oozing from the amputated stump. We should bear in mind that the blood and lymph vessels frequently run parallel to each other so that leakage without producing inflammation supplies material sufficient to form membranous adhesions.

3. All abdominal sponges must be returned to the attendant nurse; should a piece of gauze or any other foreign body remain, it seeks for an outlet or becomes encysted.

4. Sponges should not be allowed to travel upward during a pelvic operation, nor allowed to pass downward among the intestines while operating on the gall-bladder or stomach. Experimental surgery on animals for the purpose of creating artificial adhesions, proves that the mere rubbing of the surface of the liver with dry gauze removes the capsule of Glisson and produces adhesions to the adjacent organs.[1]

5. Injury to a healthy organ by grasping the same with a volsellum forceps should be avoided. One ligature of fine silk, or chromicized catgut, ought to suffice to control the hæmorrhage of a spurting artery. The bunching of the broad ligament after the removal of the uterine adnexa, leaves denuded spaces. The Staffordshire knot of braided silk to ligate the stump, should never be used.

6. Rough manipulation of the intestines or their exposure for any length of time seems unwarranted. Prolonged operation under ether anæsthesia paralyzes the entire intestinal tract for days, causing retroperistalsis. Before normal peristalsis becomes established, agglutination and later firm adhesions may have occurred among the intestines.

7. Toilet of the abdominal cavity before closure, is a thing of the past and out of date. The injury caused by rubbing may prove disastrous; liquid blood retained, beneficial. Blood clots should be removed before closure. Should drainage be needed, the vaginal canal is the safest route to drain the pelvis.

8. Avoid contact of the intestinal serosa with tincture of iodine covering the abdomen, also contamination of the peritoneum with antiseptic solutions such as bichloride of mercury. Filling the abdominal cavity with salt solution, or sponging the abdominal organs with sterilized cam-

[1] F. C. Mann, Mayo Foundation.

phorated oil, grafting embryonal tissues or other membranes on denuded peritoneal wounds, have all proved failures in preventing adhesions.

In order to prevent subsequent adhesions of denuded peritoneal wounds produced by the removal of membranes, I have covered the defects with silver foil. In suppurating cases requiring drainage, I apply the foil over the stump and then insert a drain covered with silver foil.

During the last 6 months, I have had occasion to use the silver foil on eight patients.

On account of persistent vomiting, rupture of the abdominal wound in a young woman operated upon for salpingitis occurred in October, 1903. I found the small intestines completely covered with silver foil. The foil had been used as a primary dressing. The serosa of the intestines looked normal and not even congested, only at the mesenteric insertion there appeared spots of lymph exudate. A thorough scrubbing with salt solution in order to remove the silver, proved ineffectual, hence with considerable misgivings, I returned the whole mass into the abdomen. The patient, however, made a speedy recovery and never complained of intestinal trouble.

Of the eight patients operated upon, all recovered without wound infection, and were relieved by removing the cause.

Case 1. Mrs. K. age 50. August 23, hysteromyomectomy, spinal anæsthesia.

Case 2. Mrs. B., age 53. August 28, postoperative hernia, after hysteromyomectomy June 30, 1919. Ether anæsthesia.

Case 3. Mrs. S., age 30. September 28, pyosalpinx and ovarian abscess, ether anæsthesia. Bartholinitis May 1919.

Case 4. Miss J., age 27. October 19, retroflexion, ether anæsthesia.

Case 5. Mrs. V., age 26. November 4, retroversion, firm adhesion of right ovary to a loop of intestine. Appendectomy 1915, ether anæsthesia.

Case 6. Mrs. R., age 36. December 7, retroversion Relapse after suspension 1910. Ether anæsthesia.

Case 7. Mrs. R., age 34. December 28, retroversion,, ether anæsthesia.

Case 8. Mrs. F., age 42. December 30, cholecystectomy. Adhesion of gall-bladder to colon. Ether anæsthesia.

For retroversion of the uterus, I chose the Baldy Webster method. To the sutured, plicated, round ligament, I applied a small strip of silver foil. In the case where a firm band of adhesions had formed between the right ovary and a loop of the ileum, it was necessary to excise a portion of the ovary. After removal of the membrane, both organs were separately sutured, the wounds dried and then dressed with silver foil.

After removing the fibroid uterus (Case 1), I applied a leaf of silver foil over the cervical stump and posterior flap which had been denuded of its peritoneum, owing to an adhesion to the cul-de-sac.

In Case 2, I separated the omentum from the abdominal wall and applied silver foil to the denuded surface.

In Case 3, a most satisfactory result was obtained following operation for gonorrhœal salpingitis. Patient was first seen May 7, 1919, and was suffering from an acute swelling of the left Bartholin gland, Evacuation of pus brought relief. An examination later found the uterus and internal organs in normal condition and position. A year later, during September, 1920, while menstruating, she was seized with violent pains, accompanied by chills and fever. On examination of the pelvic organs on September 27th, the uterus was found retroverted and fixed to an indefinite mass on the left side; the right tube felt enlarged and the ovary tender to the touch. Cœliotomy was done September 28, 1920; both tubes were excised together with the left ovary and vermiform appendix, and both round ligaments were sutured posteriorly to the fundus uteri. Silver foil was applied to cover the stumps and over the sutured ligaments. The left ovary and tube had been found enveloped in a pus sac, adherent to the bladder, colon, and omentum. Examination 4 months later, January 22, 1921, showed the uterus in normal position, freely movable; the left pelvic and Douglas cavity, perfectly clear and free from pathological changes; the right ovary, slightly tender to the touch, in normal position. Menses were regular, every thirty days, somewhat painful.

Case 8. Base of gall-bladder could be easily detached from the adherent colon without wounding the serosa of the bowel. Excision of the organ was followed with considerable oozing from the liver, requiring a suture at its lower border. Before closing the peritoneum, a large drain, covered with silver foil, was placed in the bed of the excised gall-bladder. The drain was removed on the fifth day, the oozing having ceased. The wound closed of itself a week later when the patient left the hospital.

Mindful of my first experience (1903) of the harmless nature of silver foil, I did not hesitate, where I found the indication, to apply the same to the wounded abdominal serosa or peritoneum.

Bacteriology confirms the antiseptic properties of silver. We have learned to use the foil as a primary dressing on wounds from Halsted, of Baltimore, and prior to this, from Marion Sims, whose art in healing bladder fistulæ was without doubt due to the use of the silver wire suture. Later non-toxicity of silver was proved in the buried suture and its introduction in aneurisms.

From my own observation I feel warranted in proposing the application of silver foil to the amputated stumps of the infected fallopian tubes. It may possibly inhibit the vitality of latent germs embedded in the tissues of the severed adhesions, but it acts especially as a protection against subsequent adhesions of the denuded peritoneum which cannot be closed by suture.

# NOTES ON THE HADRA-MARTIN-RAWLS OPERATION FOR CYSTOCELE[1]

By THEODORE J. DOEDERLEIN, M.D., Chicago

As the essential steps of the Hadra-Martin-Rawls operation for cystocele are, first free dissection, mobilization and elevation of the bladder, second, dissection of the pillars of the bladder and fascial structures underlying the vaginal mucosa back to the arcus tendineus, third imbrication of the pillars by transverse mattress-suturing, I deemed it not inappropriate to name those observers, to whom credit of priority in the perfection of this operation belongs, in their chronological order in the title of my article.

Hadra, of Texas, in 1887, first saw the necessity of thoroughly mobilizing and elevating the bladder in his operation for cystocele. Martin, in his book entitled *The Supporting Apparatus of the Female Genitals*, gives splendid illustrations of the uterofascial ligaments known as pillars of the bladder and, as a result of his research work, in 1911, developed his technique for the cure of bladder prolapse uniting the lateral fascial bundles. Rawls, in March, 1918, published his method of overlapping these bundles.

If we take into consideration the probability that the most frequent cause of cystocele is detachment of the bladder from the uterus and implantation lower down during and after childbirth, the logical cure of cystocele is detachment and elevation of the bladder and re-enforcement of its supports. The interposition operation, unnatural as it is, appeared to accomplish these ends in a most admirable way. It thoroughly detached and elevated the bladder and placed a solid support under it. Soon, however, complaints were heard as a consequence of this utter disarrangement of natural anatomical relations. We all had our unpleasant experiences with this method. Ares tabulates 37 cases of which 21 had unfavorable results. Of these 21, 50 per cent developed cystitis. There are certain cases in which this operation still has special indication but the number is limited.

Instead of placing the uterus under the bladder as a support, the method of strengthening the bladder pillars as perfected by Rawls is the anatomically correct one for correcting cystocele although not always feasible. It is, simply stated, the Bassini operation for hernia applied to the pelvic floor. Rawls' description as published in the *American Journal of Obstetrics and Diseases of Women and Children* is as follows:

"A small volsellum forceps is applied to the mucous membrane of the anterior vaginal wall about 1 centimeter above the cervix and another forceps about 1 centimeter below the external urethral orifice. Between these forceps a vertical incision is made through the mucosa and superficially into the underlying tissues. As soon as an edge on either side can be grasped with Allis forceps they are used as tractors and the incision is carefully carried forward until, in the mid-portion, the bladder can be demonstrated by blunt dissection.

"This blunt dissection is continued downward until the cervical attachment of the bladder pillars and the so-called uterovesical ligament are demonstrated. The latter is cut with scissors, keeping well in mid-line to avoid severing of the cervical attachments of the bladder pillars.

"The bladder is now separated by blunt dissection, using the gauze-covered finger, from the cervix upward to the peritoneal reflection and laterally well out to either side. By further blunt dissection the bladder is separated from the underlying pillars upward to the urethra and well out on either side. If there is a urethrocele, the dissection is carried up to the external urethral orifice. When the bladder is well mobilized, the bladder pillars are dissected from the underlying vaginal mucosa.

"In the mid-line the fascia and underlying mucosa are most often densely adherent and it is only with the greatest care that the true line of cleavage can be demonstrated. Too often at this point, by haste or the cutting of unidentified structures, the fascial sling is destroyed or buttonholed and we will fail to demonstrate a firm connective tissue. With the technique which I shall now describe I have always been able to demonstrate the bladder pillars even in elderly multipara with a long-standing prolapse.

"With a finger under the mucosa as a guide on which to cut down, the thinned-out fascial edge is dissected with a knife from the underlying mucosa. The mucosa flap is made paper thin and as soon as possible Allis forceps are applied as tractors to the fascial mucosal edges. This cutting dissection is continued from the mid-line, downward and upward, for a distance laterally until by blunt dissection a distinct line of cleavage is demonstrated the whole length of the primary incision. The mucosa is now easily separated, by

[1] Read before the Chicago Gynecological Society, January 21, 1921. For discussion, see p. 103.

blunt dissection, from the overlying pillars well out on either side to the arcus tendineus. Thus is demonstrated the strongest and thickest portion of the fascia which gives us two fixed points from which to estimate the amount of overlapping necessary to take up the slack in the fascial sling. The dissection is quite extensive but is comparatively free from bleeding unless by accident we injure the vaginal plexus of veins or the vaginal branch of the vesical artery which runs on the pubovesical ligament. The bladder and its lateral true ligaments are freely mobilized and the latter are overlapped from side to side by transverse mattress sutures of medium kangaroo tendon, at the level of the internal os one or two sutures entering the cervical tissue."

Having read Rawls' article in 1918 I was so impressed with the logical simplicity of his method that I at once applied it.

The first case, a woman 65 years old, of average weight, was suffering from prolapsus of the second degree, with eroded and hypertrophic cervix, a marked cystocele and the ordinary symptoms of cystic irritation. I carefully followed Rawls' technique, being surprised at the ease with which I could make the fascial separation. I amputated the cervix high up placing the first chromic catgut pillar suture directly above the line of amputation and carefully covering the cervical wound. Result perfect to this day.

In the succeeding 6 cases I was equally successful in finding the line of cleavage of the bladder pillars and dissecting the fascia back to the arcus. Of these cases I wish to refer to one only, a young mother of two children, who desired further offspring.

On this patient a Gilliam operation had been performed a year before in Milwaukee for the relief of cystocele and retroversion. The retroversion was cured but the cystocele remained unaffected. Her cystocele was of unusually large size and I expected very thin fascial structures and difficulty separating them. The operation went smoothly and the result to this day, 18 months, is perfect. This was one of the most grateful patients I ever had because she had been incapacitated by the almost gooseegg-like mass protruding and the cystic irritation.

In this case we had this marked cystocele without prolapse or cervical trouble, which goes to prove that cystocele of a most pronounced type may be present without prolapse, being due solely to a lowering of the bladder and weakening or separation of its pillars. I am somewhat anxious to learn what the result of labor will be as far as my newly constructed bladder pillars are concerned.

At first I approached this operation with some apprehension lest I would be unable to separate the fascia from the mucosa. As a matter of fact the fascia and mucosa are quite often firmly adherent in the mid-line, and it is difficult to find the line of cleavage. In a series of 6 cases, following Rawls' technique, I had good success in my dissection of the fascia and I commenced feeling secure. Then came a number of cases on which the operation was extremely difficult, the difficulty reaching a climax in a case operated upon only 6 weeks ago. After prolonged dissection I had nothing but useless fascial shreds and was utterly unable to approximate, much less overlap, whatever I had left of the fascia. Withal I had a very thin buttonholed mucosa. The best I could do was to sew the fascial border to the sides of the uterus and draw the broad ligaments over the cervix, thus doing an interposition operation with my distressingly thinned out mucosa covering the uterus. This patient already has complained of bladder-irritation, especially troublesome at night time.

One patient with a pronounced cystocele, some descensus uteri and cervical hypertrophy, an important case, I gave special attention as to vaginal asepsis. I always have been alive to the danger of infection and its disastrous consequences. The operation went smoothly. The arcus tendineus was reached easily and postoperative appearances seemed full of promise. Unfortunately this patient developed a most intense coli infection with high fever, great prostration and profuse suppuration. It took endless vaginal care lest my carefully placed mattress sutures and the whole work would be in vain. In this case my habit of occasionally placing a small cigarette drain into the subvesical space directly in front of the cervix, stood in good stead. Through this opening I saved my chromic catgut stitches and thus obtained a good result in spite of the pus.

It is a well known fact that cystocele, prolapsus, and even procidentia occur in nulliparous women. Kepler collected 151 cases and classifies them as follows:

1. Cases due to congenital defects which occur in the newborn or at the time of puberty.
2. Cases not due to congenital defects occurring later in life.

By far the greatest number of cases are met with in women with a history of severe labor especially with rapid instrumental deliveries. As early as 1903 Schatz pointed out, and has been referred to by Dr. Ries in 1918, that with the descending head, especially with rapid descent by the aid of forceps, the vagina is pulled down and is stripped off the bladder, which means that the anterior fornix of the vagina is almost obliterated and the bladder by a "sliding detachment" (Ries) is implanted lower down. This condition may reach so great an extent as to produce a direct relationship between the peritoneum and vaginal wall. Also Ward in 1919 calls attention to this type of obstetrical injury by

means of which the anterior fornix is obliterated. He states that the lengthening of the anterior vaginal wall, by actual measurement, is 5 centimeters, i.e., from the normal length of 6 centimeters to the lengthened condition of 11 centimeters creating what he calls the "weak spot."

In almost all my cases there was some degree of uterine descensus reaching in some instances a pronounced condition of prolapse. This descensus and prolapse were met with nothing else, besides, of course, the imbrication of the bladder pillars, than amputation of the hypertrophic cervix and levator suture, eliminating opening the abdomen. No doubt the shock incident to intraperitoneal work, no matter how little is done, is not present in external operations, and one reason why I became so enthusiastic for this fascial method was that it subjected the patient, especially the poorer operative risks, e. g. the aged, to less danger immediate and remote.

I admit the technical difficulties are much greater than in any of the other methods in vogue, that the possibility of infection is greater and not without danger to life. Louis Frank, of Louisville, reports a death from infection after an interposition operation, and I, as stated above, had my unpleasant experience. The advantages, however, are so manifold that wider adoption should be advocated.

We will, of course, meet cases where the fascial structures are thinned out to such an extent that the bladder pillars are practically useless for our purpose, where the accompanying prolapse is so severe or the intra-abdominal pathological conditions present are of a nature that other operative measures must be employed. If we remember, however, that this operation is applicable to cystocele both in parous women as well as in those past the climacteric we appreciate its value and wide range of applicability.

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# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held January 21, 1921, Dr. Arthur H. Curtis, Presiding

### PAROVARIAN CYST

Dr. William M. Thompson: I would like to show a specimen of parovarian cyst which measured 7 inches in length and 4 inches in width when it was removed. The cyst was kidney-shaped, was situated below the fundus, and encircled the cervix. Undoubtedly it would have had a long pedicle if it had been allowed to remain, as pedicles increase in length very rapidly. You can see the fimbriæ at the end by turning the specimen around. The patient was a little over 2 months pregnant and complained of pressure and weight in the pelvis. She knew she had the cyst because she had been told about it before she became pregnant. The cyst was easily removed without disturbing the pregnancy, and as the appendix was found to be diseased it was also removed.

This case brings up the question: What are the results of such an operation on pregnancy and is pregnancy often disturbed? The only statistics available have to do with pregnancy complicated by ovarian cysts. At the second month or thereabouts in 20 per cent of cases, pregnancy is disturbed; at the fourth month a much less number; at the sixth month the greatest number. This is particularly true when ovarian tumors are extirpated, for the reason that the corpus luteum of pregnancy is removed and thus the stabilizing influence upon the uterus is lost. From the result in this case it would seem that a parovarian cyst ought not to cause much disturbance in pregnancy if the operation for the removal of the cyst is done with due care and the uterus is not handled. There can be no question that when such cysts are discovered during pregnancy they should be removed.

Dr. Curtis: I would like to ask whether there was a corpus luteum in the opposite.

Dr. Thompson: As this was a parovarian cyst the ovary was not disturbed.

### PRIMARY CARCINOMA OF THE CLITORIS

Dr. Carey Culbertson: I have sections under the microscope of primary carcinoma of the clitoris. The tumor from which the sections were made was removed from a women 50 years of age who entered the hospital complaining of pain in the left inguinal region and dysuria. The pain had been present for 2 months and the urinary distress for 3 months. For 5 weeks she had noticed a soreness in the neighborhood of the vestibule. There had been no bloody discharge and no loss of weight. Menopause had occurred 7 years previously.

The abdomen was very fat, soft, and pendulous and no inguinal glands could be palpated. The vagina was narrow, short, and constricted; the cervix and corpus uteri, atrophic and free; the appendages were not palpable. A rough, papillary, indurated area 1.5 centimeters in diameter covered the lower one-half of the clitoris and extended to the left over the upper portion of the left labium majorum.

The growth was removed by wide dissection including the entire clitoris and the left labia. Exploration of the inguinal canals revealed but one enlarged gland from the left side, microscopic section of which showed round cell infiltration only. Sections of the tumor showed an early alveolar carcinoma.

### GASTROSCHISIS

Dr. Henry F. Lewis: The first specimen I have to show is a fœtus born in the Cook County Hospital a few days ago. The history is negative, except this: The mother thought she was about 6 months pregnant; she had gonorrhœa and had been treating herself with douches right along before and during pregnancy. She was passing a douche point on the day of entrance, when she bled a great deal and came to the hospital on account of that bleeding. The resident found she was in labor and thought he had a placenta prævia to deal with. He examined her rectally at the time. The bleeding stopped, so he allowed her to deliver herself and this fœtus came down. The membranes ruptured with escape of the scanty amniotic fluid. After vaginal examination, he diagnosed an anomaly.

The membranes are pretty well shrunken by the formalin. The fœtus delivered through the vulva with the intestines, kidneys, lungs, liver, in short, all of the organs of the chest, abdomen, and pelvis presenting. There is no sign, macroscopically, of any external genitalia. There is marked retroflexion of the lumbar spinal column, so much that the buttocks and legs lie posteriorly and parallel to the body, although there is no spina bifida. This retroflexion may have been the immediate reason for failure of closure of the abdominal cleft, which is open as far up as the umbilicus. The cord runs along here, on the membranes, to the placenta which, of course, was a placenta prævia marginalis.

The case is one of extreme gastroschisis, the abdomen and thorax being empty. Both feet are clubbed.

In this connection I report the case of a small fœtus, a little older than the one shown. It was born breech first. The child has a complete opening of the pelvis, a splitting through the pubes. The right thigh extends beyond the knee and the leg is attached 2 centimeters proximal to the distal end of the thigh. Both feet are clubbed. The baby was born outside and was such a horrible looking thing that they sent it over to the County Hospital right away. It is still living, at the sixth day.

There is a defect of the skin on the abdominal wall, running from above the umbilicus and enclosing an area as large as a half-dollar around it. This portion is covered by a membrane resembling cord tissue and, with the stump of the cord, is necrotic. The complete opening in the anterior aspect of the body extends over the whole pubic and part of the suprapubic region. There is complete exstrophy of the bladder with splitting of the penis into two parts. These parts lie at the lateral margins of the defect and 2 centimeters apart. The perineum is split to the coccyx. The portion of the bladder that is left bulges forward in two connecting circles each as large as a dime. The urine trickles over these areas from the ureteral openings. Meconium and fæces come through a rectum which bulges from just below the bladder in the median line.

There is necrosis of the cord, which has been tied, and this necrosis extends over a thin membranous area which replaces the abdominal wall in the region of the umbilicus. This, of course, is septic and a peritonitis will probably soon develop. Over the lower back is a flaccid, skin-covered sac about as large as half of a golf ball, probably a spina bifida.

Except for these anomalies, the child, of about 36 weeks' gestation, is healthy, seems in no pain, eats, sleeps, and cries normally.

### CRANIORRHACHISCHISIS

Here is another specimen, which I have not seen before, but the internes have told me about it. It was born in the Cook County Hospital last night.

It has a flat head but it has a brain. The cranial bones are small but apparently intact except for the occiput. It is not a case of anencephalus but of craniorrhachischisis, of the variety known as notencephalus. You see the brain and meninges in this thin membranous sac lying behind the cranium and bulging over the dorsum of the fœtus. The brain and meninges have escaped through a defect mostly in the occiput and a small defect in the cervical and upper two dorsal vertebræ. The size of the brain is about one-third of what would be normal for a fœtus of its age, about 34 weeks.

Illustrating retroflexion of the spine which occurs in most cases of craniorrhachischisis, here is a case which occurred on my service in the County Hospital 6 months ago, of iniencephalus.

The whole head is intact but there is a defect in the occiput and in the cervical and upper two-thirds of the dorsal vertebræ. The brain is contained in the cranium and is covered by the cranial bones, but it rests upon the widely and flatly separated vertebræ, the outer margins of which are joined to the margins of the occipital defect. Thus the brain is almost completely enclosed by bone. The cranial floor and the cervical and dorsal spine are shortened longitudinally, causing a retroflexion of the dorsum of the fœtus. The anus is away up here as I show you, 1.5 centimeters behind the spinal defect. The fœtus has a protuberant abdomen, but the retroflexion was not sufficient to prevent closure of the abdominal cleft, so that it was possible for the abdominal contents to remain enclosed. There is a slight spina bifida extending below the occiput down to about the ninth dorsal vertebra.

Of course, retroflexion of the dorsum is not the only reason for failure of closure of the abdominal cleft. The two cases already exhibited of gastroschisis were obviously caused by something else. The subject of causation of monstrosities is too vast to be undertaken now.

### PESSARY REMOVED FROM VAGINA

This pessary was removed from the vagina of a woman, 60 years of age, after it had been there for 3 years. She had procidentia for many years for which, 3 years ago, a doctor in Indiana introduced this large hard rubber pessary.

The pessary is about 3 inches square with rounded corners and a round hole in the center, about 2½ inches in diameter. The posterior portion is about 1½ inches thick and the anterior two-thirds is about ¾ inch thick.

The patient was instructed to take douches for cleanliness. She tried to comply but the pessary came down and presented one corner at the vulva so that she could not get a douche point beyond it, so the douches did little good. She was nevertheless instructed to leave the instrument in and there it remained for 3 years until the discharge became so foul that she wanted the pessary removed.

I made an effort to remove it at the office, but found that I could not do so. The woman was then sent to the University Hospital, where, under an anæsthetic, I tried to saw it into two pieces with a Gigli saw, but that did not work. In the attempt I broke the saw. Then I cut the pessary up into pieces with bone forceps and removed it in that manner.

Dr. Thompson: What was the condition of the vagina?

Dr. Lewis: Very good: there were only a few small ulcerated places in the mucosa and these soon healed. A recent examination reveals a small normal uterus in a condition of senile atrophy, the uterus and bladder well up and apparently fairly well supported by the contracted vaginal walls.

### SIMULATED UNILOCULAR TWIN ECTOPIC PREGNANCY

This last specimen which I show you is one of interest to me. I obtained it at a recent operation for diagnosed unruptured tubal pregnancy, performed at the University Hospital. On bringing the left tube into view, I thought I had a twin pregnancy therein. Since it has been hardened and cut through longitudinally, I now believe I was mistaken. Dr. Nachtigall will section it for microscopical examination and the doubt will be removed. The specimen has shrunken considerably in the formalin.

The specimen consists of the left fallopian tube of a women of 33 years, pregnant for the first time, and, as she thinks, at about 4 weeks. You see that the tube has two bulbous enlargements, one at the ampulla and the other shortly proximal thereto in the isthmus. Both were, at the first view during the operation, of equal size. A little blood came out of the ampullar bulb when I ruptured it in removal and some of the collapsed chorion shortly followed. The picture shows the tube with its two bulbs, the ampullar bulb ruptured and with membranes protruding.

I thought at first that the isthmic bulb contained the second ectopic twin. However, when I split it after hardening in formalin for a week, it seemed to contain only a clot which readily separated from the cavity of the tube and did not seem adherent to the wall. There was a minute hole running between the bulbs, which was apparently filling up the proximal bulb with blood from the distal bulb during an aborted ectopic pregnancy in the latter. The blood may have escaped into the proximal part of the tube instead of through the ffmbriated extremity.

Dr. Arthur H. Curtis: The pessary case reported by Dr. Lewis reminds me of a patient whom I saw in Vienna 15 years ago. This woman had worn a pessary for 20 years. It had become embedded in the vagina in a position which a pessary ordinarily occupies, and an epithelioma had developed and grown so large that it completely covered the pessary throughout its entire extent.

### HADRA-MARTIN-RAWLS OPERATION FOR CYSTOCELE

Dr. Theodore J. Doederlein read a paper entitled "Notes on the Hadra-Martin-Rawls Operation for Cystocele." (See p. 190.)

### DISCUSSION

Dr. Emil Ries: As you may know, I have devised an operation for prolapse of the uterus which is quite different from the Hadra-Martin-Rawls procedure, and much more extensive. The experience I have had with other operations before I devised my own, and the study of the pathological anatomy of prolapse, have led me to think that the operation described this evening is entirely insufficient. In many cases it is absolutely impossible to do it because there is not enough material to do what is claimed can be done.

In the operation which I do there is extensive dissection of the bladder away from the uterus, and in that dissection I must needs encounter the material with which Dr. Rawls is doing his operation. I have often demonstrated these fascial or connective-tissue bundles of which he speaks, and I have demonstrated how thin and frail they are. However, sometimes they are quite well developed. The fundamental mistake of that operation is that it does not open the abdomen. Instead of its being an advantage not to open it, it is a decided disadvantage. If you want to do a thorough dissection of the bladder, you cannot do it without opening the peritoneum. The bladder in some cases has sunk away from the wall of the uterus to such an extent that the vesico-uterine pouch is in direct contact with the vaginal wall, while ordinarily it is not. If you look at the Halban and Tandler atlas of prolapse of the uterus you will find pictures taken from actual specimens from the dead house, demonstrating contact of the peritoneum with the vaginal wall. If you have a case like that, or even a case not quite as bad as that, and you make a bridge of connective tissue under that part of the bladder which forms the cystocele you do not hold the bladder in position; it does not bring the bladder back where it should be; it raises it up, and when the bands of connective tissue have been stretched by the filling and emptying of the bladder for some time, you have the same condition again as before.

In addition, I want to say in these cases of prolapse with a large cystocele, a little vaginal operation will not make a bit of difference. It will not hold up the uterus. You have to do other things with it. The vast majority of cases we encounter are cases of prolapse with cystocele. I am willing to agree that the older operations that were done in connection with prolapse and which were intended to take care of a part of the cystocele were poor operations. That is why I found myself obliged to devise something better. The older operations which excised a piece of vagina and sutured the edges together, inverted the prolapsed bladder wall or fastened it up on the uterus by buried sutures—I believe are defective. If you look back over the cases you operated on 10 or 15 years ago, the first thing you will find that occurs again is the cystocele. It is the hardest part to cure. In the operation some of you had occasion to see me perform at the Michael Reese Hospital in a case of prolapse of the uterus you will recall what an extensive dissection we did over the bladder, and how much care we spent on the bladder in the operation, not only from below in forming a new vaginal fornix, dissecting up the bladder from its faulty position, but in fastening it high above the uterus where it belonged, and in cases of considerable prolapse where the bladder had become separated from the symphysis, attaching the anterior bladder

wall to the posterior surface of the anterior abdominal wall. I do not know whether that description is clear to you or not. I suppose in mild cases of cystocele, where there is no prolapse, and where there is a well developed bundle of connective tissue to work with, this operation may be of some use.

Dr. Joseph B. De Lee: I want to agree with Dr. Ries about his operation for extensive prolapse. There has got to be much more done for a complete prolapse of long standing where the bladder wall is thinned out and the fascia is web-like, than this plastic operation does. A large number of women does not have a complete prolapse, but a partial prolapse, with an annoying cystocele and urethrocele which require relief. This operation in the few times I have done it has really been very successful. It is possible to dissect out this fascia, not as perfectly as I can do it with plasticin, but approximately, and in a satisfactory manner. The other day I had to vary the technique a little. This part (indicating) of the fascia was thin, and I button-holed it in several parts at the side, and I could not get a good layer, but down here to the left behind I found a good thick layer of fascia, as thick as this point (indicating) which I brought over and attached on each side in the manner of an autoplastic graft. I attached it to each side but high enough where I could get fascial structures and reconstructed a very firm base of the bladder. There is a large number of cases where this operation is indicated and it can be carried out successfully. We can hold the uterus in anteversion by attaching the fascia to it above the internal os. You see a blue button on the uterus there (indicating). Now after these two layers of fascia have been imbricated a stitch is placed through the middle of the fascial span and the bridge is anchored away up above the internal os. You push up the peritoneum and by means of volsella, pulling down the uterus without opening the peritoneal cavity, this fascia can be anchored high up. The fascia upon the uterine wall pulls the fundus forward and the cervix goes backward.

I have prepared a little model (exhibiting model) for the demonstration of the levator ani. This is a woman's pelvis made with the ligaments put in to show the fascial structures and muscle. In this connection I may revert to a discussion which Dr. Barrett and I had recently. Dr. Ries has made a very important point regarding nomenclature and I think it would be a good idea for this society to appoint a committee to establish names for these structures. Most of our discussions run afield and we get all mixed up, because we do not call things by the same name. For that reason I brought this pelvis with these muscles put in plasticin. I spent half an hour this afternoon with Professor Ranson, of Northwestern University, and these models correspond to the anatomical structures indicated and were confirmed upon the cadaver. The differences of opinion have been simply matters of names. We ought to have these various muscles named, and have the Gynecological Society accept them.

What we have tried to bring together, as you see, is the fascia (indicating). These yellow structures indicate the pillars. There is a white line to which we try to attach the fascia after it is imbricated from below, but we do not always reach the white line. If you are skillful with the needle, you can put the stitch in under the guidance of touch. This layer (indicating) goes between the rectum and vagina, and that layer (indicating) goes between the bladder and vagina. The uterus would lie there (indicating), and when labor comes on it forces the fascia down and tears it off of the uterus. It bends it out and stretches it from side to side. The operation consists in denuding from below so that you can take hold of the fascia and imbricate it and sew it as close as you can to the thickened areas of fascia over the white line.

Dr. Albert Goldspohn: I must say that the vesical columns are not actually as large as they are represented in this manikin; and the experience of the gentlemen who have so far discussed it, confirms that opinion. These structures are too delicate to be detached from the vaginal wall and used separately, as a rule. Such dissection merely weakens them. They are better used in connection with the vagina, reinforcing it. After the median wound edges of the bilateral vaginal flaps have been trimmed sufficiently, these flaps should be imbricated by sliding one completely over the other one, after the outer mucous membrane of the buried side has been sufficiently denuded to obtain a union. With chromic catgut excellent results are obtained in this way. In cases of vesicocele with moderate uterine prolapse, I detach the bladder from the uterus and broad ligaments completely and open up the anterior peritoneal cul-de-sac widely. I then implant the bladder upon the top of the fundus uteri, by carefully stitching the raw edge of the bladder peritoneum to the upper posterior border of the fundus clear across from the upper border of the broad ligament of one side to that of the other. The entire anterior surface of the uterus is then free and available for an extensive and firm fibrofibrous union with the imbricated and massive flaps of anterior vaginal wall. This union broadly made and secured with chromic gut will prevent the bladder from creeping down again, and it will also take care of a moderate uterine descensus, provided the pelvic floor is effectively restored so as to secure a stable foundation beneath. In cases of elongated cervix an amputation should be made.

In cases of vesicocele accompanied by great uterine prolapse, I do not open the anterior peritoneal cul-de-sac. After having carefully detached the anterior vaginal wall from the bulging bladder sideways from a median incision, and after detaching only the lower part of the bladder from the cervix, I reduce the expanded bladder somewhat in the median line by reefing its denuded surface with fine chromic catgut, and then limit its downward descent by a higher attachment of the imbricated vaginal flaps upon the upper part of the denuded cervix, so

as to oblige the bladder in future to expand laterally rather than downward, by the low vaginal fixation and by the doubled and shortened vaginal wall in front of it. Next in order and importance is a thorough restoration of the pelvic floor to secure a durable foundation beneath; and I then make a small ventral incision into which the fundus of the uterus with the round ligaments is drawn and durably anchored in the abdominal recti muscles and fasciæ, after all adhesions and hindering retractions about the descended uterus have been overcome. My results with these methods have been so satisfactory that I would never perform the abnormal Shauta, Wertheim, Watkins (interposition) operation upon any woman, ever so old. As long as she is living she may develop an endometritis; and then nothing but a difficult and mutilating hysterectomy would be possible.

Dr. Mark Goldstine: I wish Dr. Watkins was here to take up and defend the interposition operation. I have seen him do the interposition operation, and have followed a number of his cases for 8 or 9 years, and for 10 years I have been doing the interposition operation myself.

I do not want to enter into any controversy about the relative merits of the different operations. Dr. Ries has stated why he does not think the Rawls operation is sufficient. Personally, I cannot see where one would put the bladder in most of these cases, where you do the Rawls operation, between the peritoneum and the vaginal wall or the fascia.

In regard to deaths following the operation, I will say that if you do enough gynecology you will get a death now and then from any operation. I have seen deaths from simple curettement, and one from perineorrhaphy, and one or two deaths from the interposition operation.

As regards the interposition operation, to those of you who have not followed the writings on this subject, as outlined by Dr. Watkins, I will say that the interposition operation does not always mean the interposing of the whole uterus between the vaginal wall and the bladder. Oftentimes a part of the fundus is removed. A great many times the cervix is amputated, and sometimes the whole fundus is removed very nearly to the cervix, leaving a small stump. You take out practically all the uterus and interpose a small part of it along with broad ligaments, and the broad ligaments themselves underneath the bladder. I am firmly convinced that there are certain cases of prolapse of the uterus with cystocele that you can repair only by following the lines of the interposition operation. I am likewise firmly convinced that there are certain cases of prolapse of the uterus that the Ries operation, the Rawls operation, or any other operation for cystocele will not cure; you have to operate vaginally, you must follow some line of the interposition operation or you will not cure them, particularly those cases in old women in which the uterus protrudes from 4 to 6 inches, in which the bladder comes down on the uterus 4 or 5 inches. In these cases the uterus is extremely prolapsed and the only way these cases can be cured is through some form of interposition operation. Attaching the uterus to the abdominal wall fails in that the cystocele returns, and for some reason the cervix elongates. Why the cervix elongates I do not know. It is as much a total failure as we have occasionally in the interposition operation. Some of you gentlemen have apparently seen failures from the interposition operation. I have had probably four or five failures from the immense number of these operations I have done. In those cases you will not find the bladder coming down. You will find the vaginal wall is relaxed, the fascia is relaxed as it is in the Rawls or any other operation, and the uterus is protruding, and not the bladder. If the vaginal wall is dissected off you will find it underneath the fundus of the uterus. You will find the bladder up in the peritoneal cavity where you put it. The only way to cure such a case is to remove the superabundant uterine tissue. All these operations carry with them the repair of the posterior vaginal wall.

I rise simply to defend the interposition operation. I have seen the other operations done and am familiar with the results. I have followed the interposition operation in a great many cases for years, and after studying and using other methods I do not hesitate to say that I prefer the interposition operation. Dr. Heaney and I discussed those cases where the uterus and cervix come down at the vulva, and with the interposition operation you can leave practically the whole uterus where the fundus is not too large. Where there is prolapse of a greater degree you will have to modify the operation.

As I have said before, I rise to defend the interposition operation and to say that most of the things said against it are not true.

Dr. Channing W. Barrett: After listening to the remarks of the last speaker (Dr. Goldstine), if one believes all he has said, it is time for some one to present the other side of the question. He rose to defend the interposition operation, but defended it to such an extent as to say that no other procedure could cure some of the worst cases of prolapse of the uterus. I think we have some of the worst cases of prolapse of the uterus, that come to the County Hospital, that exist in Chicago. If we have not, I do not know where you get them. I maintain that we can cure prolapse and cystocele without the interposition operation. I don't say you cannot cure cystocele with the interposition operation, but it can be cured just as well without that operation. I would prefer to have the uterus above the bladder where it belongs, than to have it under the bladder where it does not belong, if either operation will cure the cystocele.

Going back to what has been said tonight, it would seem the vaginal operation does not do the work that is needed to be done, and there were those who have said we must follow a more anatomical and rational procedure, something that is more effectual

than vaginal plastic work; and there were those who have said these procedures do not cure, and so they were willing to operate on cases that were more pathological. We are willing to plant the uterus into the abdominal wall or plant it under the bladder to cure a cystocele. I have seen a great deal more harm come from the interposition operation than from any cystocele operation that has been done. Certain things are necessary to cure prolapse of the uterus. We must have a good pelvic floor, and that can always be made. We must do away with the redundancy of tissue anteriorly, so that it will not roll over the pelvic floor, and in doing away with that redundancy these pillars can be dealt with. I would not consider them as very essential in the operation for prolapse of the uterus. That is merely one step in the procedure. We must have the uterus out of line with the vagina, or, if it is an old woman of 60 or 70 years of age, and the uterus comes outside, the uterus can be taken out, and the broad ligaments planted into the vagina to hold the vagina upward and back. With the vagina held upward and back, you get an oblique line instead of a vertical one, and the redundancy can be done away with. These structures are not always present to any very useful degree, but with a large mobilization of the bladder you can get it back out of the way of the mucosa of the bladder.

I would like to say a few words about this manikin exhibited by Dr. De Lee, which does not correspond to the one he showed at the North Side Branch of the Chicago Medical Society the other evening. It was not a question of nomenclature but of facts as to anatomy. The specimen shown up there did not even touch the spine of the ischium. It was fastened to something away above that. The question was whether the white line ran to the spine of the ischium or not. He held it did not, and I held it did. The levator ani muscle rises from the posterior surface of the pubic bone from the white line and spine of the ischium. Dr. De Lee said he would make a public announcement if he was wrong.

Dr. William C. Danforth: Regarding the controversy over the interposition operation, I have used this operation to a limited degree for the cure of extreme cystocele where there was not much prolapse of the uterus. I have followed the papers of Drs. Rawls and Ward closely because the operation seems to provide a possible way to cure cystocele with which we have so much trouble.

After seeing the beautiful model and an operation by Dr. De Lee at the Chicago Lying-In Hospital, I used his method in a case which I thought fitted in beautifully. I attempted a careful, painstaking dissection to separate these layers, and it was done with great difficulty. This case was one of those in which the dissection was difficult. A number of speakers referred to having found occasionally cases where this separation could not be made. In my case we could not get anything that would give us any anatomical support, and were compelled to go back to the usual method which I have used before. I expect to try it again, but it seems to me, these technical difficulties are going to be the ones which will defeat the results.

Dr. N. Sproat Heaney: Dr. Danforth and Dr. Ries have summed up the principal objection to the operation under discussion. The more necessary the operation is, the less tissue we have to work with; the more necessary the operation, the more attenuated are the structures, so that sometimes we have instances where we can hardly find anything that will resemble pillars of the bladder. In smaller cystoceles this operation is sometimes satisfactory. In the big cases I prefer the Watkins-Wertheim operation. I will say that Dr. Ries' operation as I have seen him perform it, I am quite certain is a cure for these very bad cases of cystocele. I personally have not yet adopted it because I have thus far been well satisfied with the interposition operation. One objection against this operation has been made tonight — that, in the event that a hysterectomy becomes necessary, it would be almost impossible or at least a very serious procedure. Now I have done hysterectomy in two cases following an interposition. The operation in both instances proceeded without any particular difficulty—probably not as easily as the easiest hysterectomy imaginable, yet caused no particular difficulty or concern.

Dr. Doederlein (closing): The primary object of my paper was to bring this subject up for consideration, and I am glad to have heard so free a discussion for my own information because, as I stated in the paper, I was not entirely satisfied with this operation. In the first series of cases in which I tried it the operation worked smoothly, then I struck a few obstacles.

There is one thing I want to mention and that is in regard to the interposition operation being a cure for cystocele. It was not my intention at all to eliminate this operation because it does not support. It is the effects of the interposition operation on the bladder we are afraid of. In my cases I had cystic irritation and have had some unpleasant cases that keep harassing me. If we bear in mind that the Rawls operation is indicated in cystocele, and not in prolapse of the uterus so much, which was illustrated by the case of this young mother where there was no prolapse but a pronounced cystocele to the extent of a goose egg, and who desired further offspring, then it has a distinct indication, and in a case like this, where a young mother desires further offspring, I would be in a quandary as to which operation I should do if I did not know of the Rawls operation. Where there is a cystocele only I would not know what to do except this "Bassini operation" on the pelvic floor.

As regards separating the structures, referred to by Dr. Goldspohn, with due respect to Dr. Goldspohn's seniority and vast experience I would say that if we wish to have a firm hold as in large umbilical herniæ, we have to dissect the structures into anatomical layers and then imbricate them. This, in my opinion, also holds good in pelvic floor surgery.

# CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held February 18, 1921, Dr. Arthur H. Curtis, Presiding

## MALIGNANT POLYPI OF THE UTERUS

Dr. N. Sproat Heaney: The patient from whom I secured this specimen was a woman, aged 39, who had been married for 18 years and who had never been pregnant. She came to the hospital with the history of having for the past few months been menstruating more frequently than usual and more profusely. The bleeding was associated with considerable pain and cramps at the menstrual period.

Upon examination it was found that patient had a large fibroid of the uterus. Because of her age and the findings it seemed probable that we would have to do a hysterectomy, so no vaginal work was done. Upon opening the abdomen we found a pedunculated fibroid about the size of a fœtal head. The uterus was otherwise normal, except retroverted. We removed the fibroid and left the uterus in but shortened the ligaments.

Since the fibroid would not explain the bleeding I put her in the lithotomy position and removed an apparently simple polypus. It was thought to be benign, but microscopical examination showed malignancy, although the endometrium removed from the uterus was benign. I showed the specimen to Dr. Ries, who concurred in the diagnosis. I then reopened the abdomen and removed the uterus. There was a perfectly smooth endometrium with no sign of attachment of the polyp and no evidence of malignancy of the polyp.

I had a similar case 8 or 9 years ago in which the woman complained of bleeding and there was no displacement of the uterus. I removed the polypi and curetted the uterus. The polypi were malignant but the scrapings were benign, showing no involvement of the endometrium itself.

## ROENTGENOGRAM OF FŒTUS IN UTERO

Dr. Hewitt has brought along a roentgenogram of a patient showing the fœtus *in utero* just before a cæsarean section. The film was taken to determine the size of the head. It was thought to be very large and we wanted to be certain about the size of its head in relation to the pelvic inlet. There was some hydramnios and it was impossible to make out the size of the head by palpation. The films showed that the bones were very dense and the head quite large. The patient had previously had four pregnancies, the first an instrumental delivery, the second, third, and fourth all instrumental and unsuccessful deliveries, the infants dying at birth. The patient estimated that her pregnancy would terminate February 8, and that she would be at term at that time, but she entered the hospital with evidences of toxæmia. The abdomen was enormously distended, the uterus was apparently quite full, and a very large child could be palpated as well as some hydramnios. Because of her previous history and the large baby, cæsarean section was taken into consideration and the picture showed conclusively that the child was very large and the head rather out of proportion. The baby weighed 10½ pounds. I show this roentgenogram chiefly because of the beauty of the X-ray film.

## ABDOMINAL PREGNANCY FOLLOWING HYSTERECTOMY

Dr. W. A. McMillan and Dr. R. H. Dunn, Charleston, West Virginia, presented the "Report of a Case of Abdominal Pregnancy Following Hysterectomy."

The patient's parents are living and healthy. She has one sister and one brother, and both are well. Patient had ordinary diseases of childhood. She began to menstruate at the age of 13; always regular; enjoying good health; made good grades in school and at about 15 years of age started earning her own living as a piano player in one of the moving picture show houses.

On December 14 I was called to see her. I diagnosed the pain in her lower pelvis as acute double pyosalpynx and advised the application of ice, rest in bed, douches, etc., and operation later.

The patient was admitted to the McMillan Hospital January 22, 1918. On opening the abdomen in the median line we found both tubes very adherent to the surrounding structure and, after removal of the adhesions, the body of the uterus presented such an angry appearance that I determined upon a clean removal of the tubes, uterus, and diseased ovaries. As the right ovary and a section of right tube were healthy in part we stitched them up to the fold of mucous membrane which we brought over to make a smooth surface for the stump of the cervix.

The hospital records say the patient made a good recovery and left the hospital February 16, 1918. The patient seldom came under my notice after the operation and soon returned to her work as a pianist.

On July 4, 1919, the mother of the girl called me saying that she was worried about her daughter. On examination at my office I was at once impressed with a tumor in the abdomen. The girl looked well and felt well, with the exception of "cramping and the kicking in the abdomen." Upon palpation I easily made out the tumor over the left side of the abdomen, and also what I thought to be the fœtal heart beat. She told me of having sexual relations, and was very indignant toward me for

telling her when leaving the hospital that following her hysterectomy she would never be able to have a child. I sent her home and the following day her mother informed me by telephone she "was cramping" very much. Dr. U. G. McClure of hospital staff upon his return said "that girl is pregnant." The patient was admitted to Dr. Dunn's hospital on July 5, 1919, and upon digital examination nothing could be made out but a small, red, patulous os. She was examined vaginally under general anæsthesia and I could not determine anything, even though my index finger went through the opening in the remaining portion of the cervix. The patient's abdomen was cleaned up. I made my incision low over the left side of the abdomen, midway between the old scar and the iliac prominence. Upon opening the peritoneum the first thing that presented itself was the thin amniotic sac filled with its fluid and unruptured. Directly above this and over toward the left abdominal wall was a thick wall of clotted blood.

I walled off the intestinal coils carefully with warm packs so as to prevent an ileus, clipped open the amniotic sac, picked up an 8½ pound baby, clamped and cut the cord. The baby was dead. A small slipping area on the side of the baby's body led me to believe that the baby had been dead anywhere from 36 to 48 hours.

The placenta was slowly and carefully separated from the left flank under the spleen, practically incarcerated by the greater omentum. Considerable bleeding followed, but hot packs controlled this in a few minutes while I made a stab drain opening well over to the left wing of the ilium and low down. A strip of rolled rubber drain was carried through this and another in the lower end of the wound, packs were removed, and the wound closed in the usual manner. The patient was removed to her room in good condition. She was in charge of a special nurse. Soda bicarbonate solution was given by rectal drip method. Small doses of morphine were given for pain during the following 36 hours. Gas was relieved by rectal tube drains removed in 48 hours. Patient made a splendid recovery in 3 weeks.

Dr. DeLee's talk on avoiding coming in contact with the intestines in cæsarean section was a great help to me in this case for without the knowledge obtained through his experiences and also those of Dr. Davis of Philadelphia and Dr. Zinke of Cincinnati, I would have boldly gone in over the tumor with possibly unsatisfactory results.

In regret not operating sooner. Why I should have put off for a few days while the patient was suffering from the great cramp-like pains in her abdomen is explained by the false history of exposure to pregnancy. From the history of coitus I figured the patient about 7½ months. The baby's weight was 8½ pounds and a full term girl baby.

Dr. R. H. Dunn assisted me in the operation and Dr. McClure gave the anæsthetic. Miss Wills was surgical nurse and Miss Graves the assistant nurse at the time of the operation. Drs. Dunn and McClure as well as myself would like very much to know how many such cases have been reported.

As stated above the patient was delivered of 8½ pound baby July 6, 1919. Patient states that she menstruated regularly every month from August 1, 1919, to August 20, 1920. She was married in January, 1920. Her husband stayed with her through July and August, 1920. He left for New York, the latter part of August.

October 23, 1920, the patient reports at my office stating that she has not menstruated since August 20, 1920. She is sick at her stomach early in the morning. Her appetite is good. She has gained in weight. She believes that she is pregnant. She has no abdominal pains. I examined her digitally and found the cervix soft and mushy, very much the same as that of a pregnant cervix. I advised her to come again in the next few weeks. She wants to get a divorce from her husband and I have advised her to make no such request.

October 29 the patient called at my office. I confirmed diagnosis of pregnancy. The cervix was red and boggy, and the patient was sick at her stomach in the morning.

December 14, 1920, I examined patient through vagina and rectum. I felt a mass through the rectum and could make out a mass through the vagina. The patient is getting "fat." There is no sickness now and patient's appetite is good. General health good. Breasts show signs of pregnancy. Patient has made frequent visits to hospital and I have noted continued increase in signs of pregnancy.

Miss I. S. now Mrs. C. reported to me on the 14th instant with her mother and upon explaining to her the question of presenting herself at this Clinic I fortunately secured the consent of the patient and her family. She left my office about 2 p.m. of that day and spent a very busy afternoon in the shopping district of our city, afterward walking to her home up a long steep hill. About 3 a.m. of the following morning, she awakened her mother with a sudden pain in her left side. Her mother called Dr. McClure and said she did not think it necessary for him to come out. The doctor made a few suggestions for her relief. He was called again at 5:30 a.m. and went to see her. He called me about 6:30. I saw the patient about 7:15. She was pulseless, very white, tossing in bed, her knees drawn up, abdomen distended, she was suffering with pain over her left side and begging for ice water. Morphine ¼ gr. with atropine 1-150 gr. was given hypodermatically. The patient was removed as carefully as possible to the hospital in the ambulance.

Not thinking it wise to wait longer, we prepared for immediate operation. The abdomen was cleaned up in the usual way and a long incision to the left of the median line made. The tissues were almost void of blood; the patient's condition was extremely bad. From the abdomen we secured about 2 pints of clear blood by having it flow in a

sterile basin. This was given back to the patient intravenously with a 2½ per cent solution of sodium citrate.

The fœtus in this last instance was not free in the amniotic sac—floating unattached in the abdominal cavity, but the mass presented the appearance of a normal uterus on the right side by a thin layer of what looked like normal uterine tissue with a short distal end of the right tube and about one-half a normal appearing ovary on the right side. At the left side of this mass was the protruding amniotic sac with a bulging mass of bleeding placental tissue that had a strong attachment to the sigmoid flexure of the rectum. From this point the hæmorrhage was still going on. I spread this with my fingers and ruptured the thin amniotic sac lifting out a boy baby, which afterward weighed 4 pounds. I then sutured all bleeding points and closed the artificial half uterus. Hot normal salt solution was added to the abdominal cavity and the incision closed in the usual manner. Patient died about 10:30 a.m.

## DISCUSSION

Dr. Charles E. Paddock: I am not sure that I quite understood just how much of the uterus and adnexa were removed at the first operation. As I understand it, a low amputation was done and at least one tube and part of an ovary possibly left in. If this be so, a physician might with almost perfect safety guarantee to his patient that a future pregnancy was not to be thought of, still we have here an example of how guarded we must be in our statement to the patient.

In this case, a gauze drain was passed through the stump connecting with the peritoneal cavity. This may have left a connection whereby the ovum could readily come in contact with decidual tissue. The ovum imbedding itself would finally extend into the abdominal cavity attaching itself to surrounding tissue, thus becoming an abdominal pregnancy, or a tube or part of a tube being left, the pregnancy may have started in the tube. May I ask where the placenta was attached?

Dr. McMillan: In the first pregnancy the placenta was planted absolutely at the furthest point from any uterine tissue, up in the left flank under the spleen. After the baby was removed a wall of clotted blood came down from that corner of the abdomen and shortly afterward the placenta separated.

Dr. Paddock (resuming): In the second operation, may I ask another question: What did the woman die of? Was it from shock due to the rupture, or hæmorrhage at time of operation?

Dr. McMillan: The woman bled evidently from the first call at about 3 o'clock in the morning, and the abdomen was filled with blood. The girl was suffering a great deal and the doctor lifted the foot of the bed. When she was opened the abdomen was tightly packed with clotted blood around the diaphragm, and she suffered with severe pain in the region of the diaphragm.

Dr. Paddock (resuming): How often we think we might have done differently when listening to such a report as the one now before us, and perhaps had we been the operator we would not have done as well, or at least no better. I had thought perhaps it might have been better had the child been removed, the tears repaired as quickly as possible, no clots removed and the placenta left *in situ*, and the abdomen closed. Instances of the placenta having been left in the abdomen are cited and after a few weeks the placenta becoming entirely digested.

There is great danger of doing too much and the patient succumbs to too much manipulation. "Get in and get out as quickly as possible" is a good motto.

Dr. Rudolph W. Holmes: Some years ago some German operator hysterectomized a woman who some time later became pregnant in the cervix and possibly some slight portion of the lower uterine segment—she aborted in a few weeks.

As the essayist describes it, one would be led to believe that his case was an instance of primary abdominal pregnancy with an attachment of the placenta to some viscera. This is so contrary to the usually accepted view that nidation only may take place on muellerian tissue that we must believe that the nidation must have been primarily in the remnant of the tube left. The fact that the omentum supplied some of the nourishment would be proof positive that it was not primarily so attached unless microscopic proof were advanced to prove muellerian remnants were in the omentum. The recurrence of the phenomenal pregnancy likewise proves that the primary nidation must have been on muellerian tissue, that both had taken a course analogous to a continuation of growth of a tubal pregnancy after its rupture.

Horrocks, of London, has had an unusual experience with advanced ectopic pregnancy. In his many cases it is his custom to remove completely the placenta at the time of operation, he maintaining that it is readily possible to work along the line of cleavage between placenta and attached structures so that it is consumated with minimal amounts of bleeding if proper ligation be done. *A priori*, it would be better surgery to follow his teaching, rather than to pack and have the necrotic placenta disintegrate and come away later spontaneously, or by a secondary operation. On the other hand I imagine it would be a dangerous procedure to close the abdomen and trust that the placenta would prove innocent and be absorbed without undue symptoms.

Dr. McMillan: First, in regard to the length of the cervix, there was about 1½ inches of cervical tissue left. There was also about half of the right ovary left and about 1½ inches of the fimbriated end of the right tube.

Regarding the cause of death, I felt that the patient was dying; she was rapidly becoming worse. I felt that without an exploratory operation I would be a coward not to give her the possible

chance of tying off or packing off the bleeding point. Without the exploratory incision I would have been unable to tell what the abdominal contents were, for we, unfortunately, have a state law whereby we are unable to secure postmortems unless the friends give the privilege, and there is a decided feeling against granting postmortem examinations.

I want to say that in the first pregnancy the young woman had no pains up until the day before I did the first operation, and she went into labor with just normal labor pains and the length of time necessary. I wish also to state that there were no intestinal adhesions to the placenta or to any abdominal viscera. The placenta came away without any difficulty and there was not much bleeding after it was separated. It was easily packed off and after waiting a reasonable length of time to establish my stab drain down in the left abdominal wall I felt quite safe in taking out the hot packs. The placenta was in the left flank, over the left kidney and under the spleen. It came down from that region with very little trouble. I had made a long incision and I made careful observation at that time and there was no difficulty in separating the placenta.

Death was not due to hæmorrhage at the time of second operation, I feel certain of that. She had bled about all that there was to bleed. There was slight oozing and she had only about half of the right wall on the cervical portion of the tissue which presented a uterine structure. It bulged out over the attachment of the placenta to the rectum and that mass was the thin amniotic sac. In the second instance this was very tough and the omentum came down and was also adherent to the mass. I did not encounter any adhesions or attachments to any of the lower structures.

Dr. Charles S. Bacon: I would like to ask the doctor how he thinks the woman became pregnant.

Dr. R. H. Dunn: At the time of the first operation, when the hysterectomy was done, we put in a little rubber dam drain and there was a fistula of the cervix following the drainage resulting in loosening and breaking away of the interrupted sutures.

Dr. S. S. Schochet. The two cases here reported are very interesting in regard to the point of attachment of the placenta. We are dealing with a tubal pregnancy or a pregnancy which had become detached from the cervix and gained a new attachment. Many observers seriously doubt the validity of the so-called primary abdominal pregnancy.

Dr. Joseph L. Baer: I wish to call attention to the fact that in the case report it states that there was much available tissue, an inch and a half of the tube remaining so that it or the stump of the uterus could have been the implantation site.

Dr. N. Sproat Heaney: Dr. Schochet's explanation seems the right one. The doctor operated for pus tubes and the distal portion of one tube was left in. The doctor had quite a complicated operation at that time and thought he had removed the tube but had not. By the same token he left more of the uterus than he thought. He closed it up and put a drain in. I think there was enough of the uterus left to start the nutrition of the pregnancy since there was enough to menstruate. This woman had labor pains in her first pregnancy which can only be produced by a contracting body (the uterus) and when the labor pains stopped this uterus, which was markedly distended, ruptured into the amniotic cavity and the fœtus and placenta were all shed into the abdomen. The placenta was removed without any bleeding or any raw surface, which would speak for placenta that had been unattached. The second time the uterus had no closure of the fundus and the pregnancy started on a portion of the uterus and spread out onto the neighboring organs and we had more of an abdominal pregnancy than the first time, but it started in the portion of the uterus that was left above the cervical stump.

Dr. McMillan (closing): I wish to thank all the gentlemen for their liberal discussion. There is another point to remember; the woman had enough endometrical tissue to menstruate every month, she had 1½ inches of the fimbriated end of the tube and half or more of a good right ovary. She established a line of apparent uterine tissue in her second pregnancy that she did not have in her first pregnancy.

## RESULTS WITH INTRAPERITONEAL GAS INFLATION AND THE X-RAY AS AIDS TO OBSTETRIC AND GYNECOLOGIC DIAGNOSIS

Dr. Reuben Peterson, of Ann Arbor, read a paper on "Results with Intraperitoneal Gas Inflation and the X-ray as aids to Obstetric and Gynecologic Diagnosis." (See p. 154.)

### DISCUSSION

Dr. Joseph L. Baer: I am going to ask Dr. Peterson to give me reassurance in some work that I have been trying in a small way in the Michael Reese dispensary. I have been interesting myself particularly in the sterility cases, using the Rubin transuterine gas introduction, and I have been exceedingly fearful of introducing infection: first, with infected gas; second, by blowing up an infection into the uterine cavity from a cervix that I have just penetrated with a sterile cannula; third, through stumbling unawares upon a quite fresh gonorrhœal infection, with patent tubes but still with an active process just under way, and so on. I have checked myself as best as I could by, first, a history of the patient, eliminating everything that would point toward an infectious state of the pelvic viscera; second, by a bimanual examination, likewise attempting to eliminate such dangers; third, a temperature and a white blood count, holding myself to those cases in which the temperature and white blood count are normal.

I have used a cannula like Rubin's with the little rubber stop and so far I have been using oxygen. The introduction of the cannula is comparatively

easy, but I have found it necessary in some cases to go to 200 millimeters of mercury pressure, and then have found the tubes to be patent.

I am very much impressed by the device Dr. Peterson is using for measuring the gas. Dr. Rubin's is not so satisfactory, and I have never been so sure of the quantity used. His method is based on the "tempo" of the gas bubbles. You try to establish the rate and then maintain it, but as soon as the pressure increases the rate decreases, the flow very soon ceases, and so you have to keep adjusting.

I think Dr. Peterson does not wash the gas in sterile water, at least I did not hear him say anything about that, nor filter it through cotton, nor does he look upon it as infection-carrying *per se*. I wonder whether he looks upon it as sterile because of the pressure under which it has been, and whether pressure itself is a germ killer. I confess a total ignorance in that field.

I have a film here which it may interest you to see, for it shows how clearly the diaphragm is marked and how the liver is separated from the diaphragm by the rising oxygen introduced by way of uterus and tubes.

Dr. Carey Culbertson: That which makes for greater refinement of diagnosis is admirably brought out in Dr. Peterson's excellent presentation this evening. There is one point which I might mention. I have not used the method of inflation through the tubes which Dr. Peterson has demonstrated, but at the County Hospital I have examined some patients by transperitoneal inflation. The patient is placed upon a table that can be tipped either end down and everything is gotten ready. This is done in the fluoroscopic room. The trocar is passed under the fluoroscope and the inflation done under the fluoroscope, so that one can watch the inflation as it takes place and can stop when the degree of distention is satisfactory. It is remarkable how little distention one needs in order to bring out the diagnostic features. It is not necessary to use much gas. I have not noticed that the patients experience so much pain as Dr. Peterson has given us to understand is the case, unless they are tipped. I think it is the tipping, standing them either on their head or feet, that causes the discomfort, so the patients are kept quiet in bed for some little time to avoid that. The small tumors are very well brought out under this method. The large tumors do not seem to be shown so well, but they are readily palpable anyway. The thing that is most satisfactory perhaps is the demonstration of the adhesions, as Dr. Peterson brought out so beautifully in some of his plates showing the adhesions of the omentum.

Dr. Charles S. Bacon: Dr. Peterson showed the early stage of pregnancy and demonstrated the thickening of the isthmus in the early stages. My understanding is that the isthmus is thinned out in the early stages of pregnancy, and I do not quite understand the relation between his findings and that thinning out of the isthmus. I would like to have him explain this a little more fully.

Dr. Charles E. Paddock: I wish to substantiate what Dr. Peterson says as to the condition of the tissue at the junction of the body of the uterus with the cervix in the early pregnancy. There is a softening, not a thinning. This is called the Credé sign of pregnancy.

Dr. Gilbert Fitz-Patrick: I wish to know how Dr. Peterson regulates the temperature of the gas.

Dr. Peterson (closing): I can only say in reply to Dr. Baer that I think the danger of infection is largely theoretical. Rubin now has used the transuterine method in some 250 cases and I have used it in over 50 cases and have seen no carrying up of infection from the tubes into the pelvic cavity. I can imagine that if the method were used carelessly in acute cases, such as Dr. Baer mentioned, possibly the infection could be driven up through the tubes. When you come to study this method under anæsthesia you will see that the gas is not forced through violently. The ampullar portion of the tube is dilated first, and then the gas bubbles very gently pass through the fimbriated end of the tube and there is no rush that would carry out infectious material. Possibly this is the reason infectious material is not carried on. I have examined many cases under anæsthesia and have studied the mechanism of the passage of the gas through the tubes. There is a danger, but I think very slight danger, if we are careful in the selection of the cases, as I have tried to outline.

In regard to Dr. Rubin's apparatus, I can say that this apparatus that I showed here is Rubin's latest apparatus. He uses the siphon meter just as I have pictured it. The only difference is that I introduce the cannula in the Sims position, and that I allow enough gas to pass into the pelvis after the tubes have been proved to be permeable to enable the X-ray picture to be taken.

Dr. Baer also asked whether the gas is sterile. I had this carefully gone over in the bacteriological laboratory, and the gas as it issues from the needle is sterile, so I do not think there is any danger from that.

As to the temperature, the gas is not cold enough to produce any bad results whatever. I am sure that with the long tube used there is no danger to be feared from the temperature.

I am sorry I did not make it clear enough as to the danger of interrupting pregnancy. I can see that unless a careful history were taken and one injected the gas through the transuterine route in doubtful cases of pregnancy it would be an easy matter to establish the diagnosis of pregnancy at once, or very soon. I was not speaking of such cases. I have yet to introduce the gas through the uterus in a case where I suspected pregnancy. In such instances I have put it through the abdominal wall.

We have used the X-ray plates in connection with this work because we want permanent records. It is perfectly possible to demonstrate 150 cubic centimeters of gas passed through the tubes, and you can see by the fluoroscope the depression of the

liver, as on the plates that were passed around, but we use the plates because we want a permanent record.

Dr. Culbertson spoke of tipping the patient as the cause of bringing on the pain. I was careful to demonstrate that the patients do not have pain, but have what I describe as discomfort. I think that pain is distinctly different. Once in a while we have had, where the abdominal examination has shown a great many adhesions and an irritable peritoneum, a patient who complained very bitterly of pain, but in the great majority of patients where you would use this method there is only discomfort. This does not come from the tipping for it comes when only 300 cubic centimeters of gas have been injected, and when you get up to 1,000 cubic centimeters the discomfort is not so great because the gas does not press upon the diaphragm, but rises up in the pelvis because the head of the patient is tipped down.

Now, as to Dr. Bacon's question about the thinning of the lower uterine segment and why it shows the thickened shadow. Besides the thickening there is a broadening of the segment. We can demonstrate this at 2 months very easily. We can feel with the examining finger this spreading out and the X-ray does not have to have a thick tissue but tissues that are separated by the gas. I think that is why we see this cross section at the isthmus.

Dr. Curtis asked me to describe a little more carefully the transperitoneal introduction of the gas. The abdomen is carefully sterilized with iodine and then the needle, which is the ordinary needle that we use for spinal puncture, is passed through the fold of the abdominal wall which is held between the forefinger and the thumb. The needle has to be sharp, or else it gives rise to pain. It is passed slowly down to the fascia. After you reach this point it is passed through the fascia and peritoneum and after you have done it two or three times you will know accurately when the peritoneum has been pierced. Once or twice we have had a plate that did not show anything after 1,000 cubic centimeters of gas had been passed into the abdominal cavity. I do not know why, but the plate showed nothing and we knew that the gas had been injected. It was suggested that perhaps I had passed it into the bowel, but I am quite certain that is not so for if we passed 1,000 cubic centimeters of gas into the bowel there would have been more pain than was experienced in these cases.

It seems to me we have just begun this study and if more men will take it up and give us their experience it will help to clear up these mooted points. After my demonstration of more than 100 cases I hope the members of this society will try it. It is a very simple procedure. It simply requires the co-operation of an experienced roentgenologist to help interpret the plates. If hundreds of these plates are made and developed and studied in connection with the clinical findings, within a short time we will have knowledge in regard to preoperative diagnosis that we have never dreamed of before.

## SILVER FOIL, A PREVENTIVE OF FORMATION OF PERITONEAL ADHESIONS

Dr. Arthur J. Puls read a paper entitled "Silver Foil, a Preventive of Formation of Peritoneal Adhesions." (See p. 186).

### DISCUSSION

Dr. Arthur H. Curtis: I think it never does us harm to have reiterated that it pays to be careful in abdominal work. Concerning the use of silver foil, I have personally had no experience, and I presume that very few members of the society have used it, at least at all extensively. During the past several years my partner and I have given up entirely the use of lap pads. We now never use pads in the pelvis, but when necessary employ a very heavy type of rubber dam, and have been pleased to note that patients do not come back to the office complaining of adhesions as they did in former times. When, in other cases, we need a pack vaginally, we also use a rubber dam or rubber glove. Whenever we find it necessary to use sponges, we have given up entirely the use of dry sponges. I think we will all improve our technique by using only wet sponges, and we should sponge only the place upon which we are working, and even there as little as we possibly can.

Dr. Charles E. Paddock: Those of us who are attempting to do the newer cæsarean operations, and the opponents who claim that the great trouble with our operations is that they are followed by adhesions, would welcome some procedure like this to prevent the adhesions. We would feel then that we had entirely overcome the opposition of those who are doing the transperitoneal and extraperitoneal operation.

Dr. Puls (closing): I have nothing to add except that I am glad the doctor uses the rubber dam instead of the old pads, which certainly do harm.

In the cæsarean sections I do not think we will get adhesions if we have a clean patient and follow the surgical principles I laid down and have a dry wound. In cases where it is doubtful whether the patient is clean and healthy, I think the silver foil will do no harm. Of course, we can tell later on if the adhesions have remained away. All of my patients have remained well, and the ones who have suffered from adhesions have been relieved.

# CHICAGO SURGICAL SOCIETY

Regular Meeting Held May 6, 1921, Dr. William Fuller, Presiding

## EXPERIMENTS WITH AN ORGANISM ASSOCIATED WITH THE CROCKER TRANSPLANTABLE MOUSE TUMOR

Dr. John W. Nuzum detailed the experimental work he has been doing with an organism associated with the Crocker transplantable mouse tumor. (See p. 167.)

### DISCUSSION

Dr. Albert J. Ochsner: To my mind Dr. Nuzum's demonstration is the most important piece of work that has been brought before the Chicago Surgical Society since its foundation. It represents an enormous amount of work extending over a 2 years including many hundreds of carefully conducted observations and resulting in the establishment of a scientific foundation for future work to establish the etiology of cancer.

He has brought out many important facts which fit perfectly into what we as clinicians have known for a long time. Hundreds of attempts at transplanting carcinoma from one patient to another or from one animal to another failed until proper conditions were established.

In order to succeed there must be enough carcinoma tissue to supply food for the infectious material until the resistance of the surrounding tissues of the new host has been overcome and enough to maintain its growth after the natural condition of the tissues surrounding the transplant has become suitable for the invasion by the cancer to give it a permanent foothold. In case these conditions are not established the growth will develop at first only to be absorbed sooner or later.

The fact experimentally demonstrated by Dr. Nuzum that by traumatizing or partly removing the growths which have been produced by inoculation with these cultures will cause the artificial growth to take on a more intensely malignant character is very significant. Clinically we have long known that pigmented moles when crushed or partially removed will acquire identical characteristics by changing from an apparently harmless condition into violently malignant growths. The trauma must have overcome natural barriers which previously prevented invasion of surrounding tissues and metastatic dissemination. The same is true in connection with the partial removal or traumatizing of cancer in man. Until this change is caused by trauma the transplanted tumors increase by expansion rather than by invasion.

In visceral inoculation metastases occur more frequently than in subcutaneous probably because there is less connective tissue to obstruct progress and because the vessel walls are thinner and more numerous.

We know that planting any kind of seed under improper conditions will not result in proper growth, hence the difficulties encountered heretofore in obtaining cultures from cancer and developing these so as to eliminate the tissue cells and then to inoculate healthy tissue in a manner to produce typical cancer.

It seems that Dr. Nuzum has made important additions to existing methods which are likely to have most valuable results because they will enable others to continue the research and possibly to produce vaccines or antitoxins.

These observations seem to be an advance on those of Payton Rous and F. Keysser which are also of the greatest importance in pointing the way.

The fact that there is no growth in ordinary culture fluids undoubtedly explains many past failures.

The further fact that the ascitic fluid used for cultures must be bile-free may be of far reaching importance. Possibly, this may explain the rare occurrence of cancer in the portion of the alimentary canal which is constantly being bathed with bile. It may explain why cancer occurs frequently on the gastric side of the pylorus and only very rarely on the duodenal side.

Nuzum has isolated a definite micro-organism grown under definite conditions the introduction of which into normal tissues under proper conditions results in the formation of tumors having the power to form metastases and to destroy life in a manner identical with that caused by cancer.

It seems especially interesting that traumatizing of these artificial growths has the same results as traumatizing malignant growths.

The fact that it has been possible to isolate what appears to be the identical micro-organism regularly in human cancer and that with proper culture media this micro-organsm can be grown and that it will produce typical growths upon inoculation seems convincing evidence to my mind that Dr. Nuzum has in fact isolated the cause of cancer.

# CHICAGO SURGICAL SOCIETY

Regular Meeting Held March 4, 1921, Dr. William Fuller, Presiding

Dr. Albert E. Halstead and Dr. Frederick Christopher read a joint paper entitled "Report of a Case: Pylephlebitis of Appendiceal Origin Simulating Lung Abscess."

## Local Anæsthesia for the Control of Chronic Pain

Dr. Frederick G. Dyas read a paper entitled "Local Anæsthesia for the Control of Chronic Pain." (see p. 184.)

### Discussion

Dr. M. L. Harris: The subject matter is one of considerable importance and should receive greater recognition in the relief of pain. We have all heard and read a great deal about operations done under local anæsthesia and how successful the method is, yet it is surprising how few surgeons are availing themselves of this extremely important addition and improvement in the way of operating.

Chronic pain can be relieved by the blocking of nerves, as well as acute pain, and I am surprised the method is not more frequently used. I have seen patients who were doped with morphine in order to relieve pain when the pain could have been relieved very easily by simply blocking the nerves with some local anæsthetic thus leaving the mind of the patient perfectly clear.

For some time I have been doing this not only with the use of alcohol but with local anæsthetics combined with certain substances, such as calcium and magnesium, which prolong the anæsthesia. I have been able to relieve intense intercostal neuralgia in patients who had been kept night after night with anodynes by injecting the intercostal nerve after its exit from the spinal foramen.

Chronic pains about the feet, particularly in the region of the heel due perhaps to gonorrhœal infection may be relieved by the injection of a local anæsthetic. The patient gets not only immediate relief of the pain which comes from the local anæsthetic, procaine, for instance, but after that effect has worn off, there will come a relief from the pain which may extend over days.

It seems to me, this method should be used more frequently. It is one of the best methods of relieving chronic and acute pain with which I am familiar, namely, blocking the nerves with proper combinations of local anæsthetics.

Dr. Roger T. Vaughan: The members of this society all know what a reputation for uncertainty as to both diagnosis and prognosis the condition called coccygodynia has, the variety of conditions that cause it, and how capriciously it yields to treatment. In a patient whom I am still treating the pain is localized to the tip of the coccyx, where I can make out rather definitely both on rectal and external examination a small circumscribed area of tenderness. I injected this tender area with novocaine as a prognostic measure. I believed that if I could relieve the pain by novocaine, I could secure permanent relief by subsequent alcohol injections. Yeomans has reported a score or so successes in coccygodynia from the use of alcohol injections.

Novocaine gave the patient complete relief for 24 hours. I followed that a week later with alcohol about 70 per cent, and the patient again had complete relief for 24 hours, and partial relief for the ensuing week. Encouraged by this success, I injected 95 per cent alcohol, hoping to secure more lasting improvement, and made bolder because the preceding analgesias obtained had not been accompanied by any area of cutaneous anæsthesia or other untoward signs. The usual analgesia lasted over night, but the patient for the ensuing 10 days suffered more pain than previously.

A series of injections appears to be necessary in these cases, as Yeomans has observed; but so far as I have been able to ascertain from the literature, novocaine has not been used as a diagnostic or prognostic measure in these cases. I, therefore, mention this single case chiefly to secure Dr. Dyas' opinion and the opinions of the members of this society as to whether they believe such an injection of novocaine has diagnostic or prognostic value in cases of neuralgia in which alcohol treatment is under consideration.

Dr. Dyas (closing): To bear out what Dr. Harris has said, I believe these injections should be persisted in frequently. For some reason or another, even with novocaine permanent relief ensues. In the work Dr. Vaughan has done he might with considerable justification carry out his initial treatment with the novocaine or with solutions of alcohol, but not quite as strong. It seems to me, this method will be used more and more in the future, and we will be required by the public in general to be able to control pain in a more accurate and scientific way rather than give a patient ever-increasing doses of some form of opium. I believe these nerve injections have some action on the nerve which tends to restore things to a normal condition.

In cases of intercostal neuralgia and coccygodynia and other painful conditions, this method ought to be tried out to the limit.

Dr. David C. Strauss read a paper entitled "Subcutaneous Rupture of the Liver."

# CORRESPONDENCE

## SARCOMA OF UPPER END OF HUMERUS; OPERATION; NO RECURRENCE

*To the Editor:* In the January, 1920, number of SURGERY, GYNECOLOGY AND OBSTETRICS on page 7, Albee in his article entitled "Restoration of Shoulder Function" reports a case of resection of the humerus for sarcoma, and further notes that "William B. Coley in recent correspondence states that it is the only case that he knows of in which a resection for sarcoma of the humerus was done and no recurrence occurred after 18 months." For this reason, if for no other, the following case report will undoubtedly be of interest to your readers.

February 20, 1916. Mrs. A. K., age 40, the mother of 8 children, born in Russian Poland, states that for the past 8 months she has had intolerable pain in her right shoulder, day and night. She is unable to sleep for more than a half hour at a time on account of this intolerable boring pain. She is losing in weight and well-being and begs for some operation, no matter what its consequences might be, which would offer her some hope of relief from the intolerable pain.

She gives the usual personal history of a hard-working, married woman, mother of a large family. She has never had any serious illness, never had any miscarriages or any of the usual signs and stigmata which might lead one to suspect syphilis. She has never had a chronic cough, nor purulent expectoration. She states that for many months past she has been a patient at one of the largest hospitals in this country, where a diagnosis of inoperable tumor of the shoulder-joint was made. She states that repeated blood tests have been made and that they all were negative, but that, on the suspicion that the condition might be of syphilitic nature, she was given six injections of salvarsan without avail.

She was examined by me at my office on February 20, 1916. There was a complete loss of motion of the right shoulder and a large, hard, tender mass was felt over and to the inner side of the head of the humerus. There were no glandular enlargements and no lesions suspicious of syphilis. The examination of the lungs was negative, heart and internal organs normal except for relaxed vaginal outlet and a cystocele.

X-ray photograph of this date is shown in Figure 1. The diagnosis lay between sarcoma, cyst, syphilis, and tuberculosis. The subcutaneous tuberculin test, made with increasing doses, was negative for a dose of 2 milligrams of Koch's old tuberculin. The Wassermann reaction was negative

Fig. 1.

Fig. 2.

Fig. 3

Fig. 1. Roentgenogram of patient taken at the time of examination.

Fig. 2. Photograph of tumor.

Fig. 3. Recent roentgenogram of patient's shoulder.

and an authentic copy of her previous hospital record shows that repeated Wassermann examinations were negative, even after provocative doses of salvarsan, and that salvarsan given in large doses during a period of 4 months did not ameliorate her symptoms, but rather the tumor had grown in size and the pain had increased in severity while she was being thus treated. A diagnosis of sarcoma of the upper end of the humerus having been made, an operation was performed on March 12, 1916, at St. Luke's Hospital, Cleveland, Ohio, the upper 4 inches of the humerus being resected and removed. The tumor mass was a solid one, no cysts, and did not involve the glenoid cavity or the corocoid process.

A 6-inch graft was taken from the shin and implanted into the medullary cavity of the upper end of the humerus and fixed under tension in a hole bored into the glenoid cavity of the scapula.

The tumor was photographed, Figure 2, and the pathological report showed the growth to be a mixed cell sarcoma. This diagnosis has been confirmed by Dr. Karstner, pathologist at Western Reserve University.

The patient made an uneventful recovery and was soon able to leave the hospital with the arm and shoulder in a plaster cast. Eight weeks afterward the cast was removed, the muscles massaged to regain their tone. Since the twelfth week after the operation the patient has been able to do her housework and is now able to take care of her family of husband and eight children unassisted, doing the washing and ironing. X-ray photographs taken within the last 6 months, Figure 3, show a good union of the graft with the humerus, no union of the graft with the scapula and that the tumor has *not* recurred locally. Careful physical examination shows that the tumor has not recurred in any part of the body, the lungs being negative to the X-ray plate. The patient now makes no complaint of any trouble referable to the osseous system.

Walter G. Stern, M.D., F.A.C.S.
Orthopedic Surgeon, Mt. Sinai Hospital
Cleveland.

## TECHNIQUE FOR HYSTERECTOMY WITH INFECTED AND MALIGNANT CERVICES

*To the Editor:* I am prompted to mention the method which I shall describe, after having read an article on "The Treatment of Suppurating Wounds Following Abdominal Section," by Dr. Thomas J. Watkins, in Surgery, Gynecology and Obstetrics, 1921, xxxii, 87. Dr. Watkins refers to the danger of infections following hysterectomy for cancer of the cervix and infected protruding fibroid polypi. I would mention any variety of infected cervix in addition thereto.

I would submit the following procedure:

1. Cleanse the vagina by any of the standard methods, presupposing proper pre-operative preparation.
2. Cauterize the cervix with a hot iron.
3. Make an incision at the cervicovaginal junction as in a vaginal hysterectomy, except the lateral attachments are not severed, thereby avoiding the uterine vessels at this point.
4. Encircle the cervix with an elongated gauze wipe and pack same loosely into incision.
5. Grasp the cervix firmly with a volsellum and lock securely.
6. Proceed with hysterectomy in ordinary manner through the abdomen. When uterus is freed of all attachments, have an assistant grasp the volsellum and deliver same through the vagina.

The advantages are obvious.

Charles W. Doughtie, M.D., F.A.C.S.
Norfolk, Virginia.

# AMERICAN COLLEGE OF SURGEONS

## SOUTH AMERICAN SURGEONS

Report of Official Visit to Ecuador and Bolivia in Behalf of the American College of Surgeons, by Francis P. Corrigan, M.D., F.A.C.S., Cleveland, Ohio

### I. Foreword

#### 1. *The Mission*

IT is a great pleasure to be able to report to the Fellows of the American College of Surgeons the completion of the mission on which I was sent to Ecuador and Bolivia, as the result of which the most prominent surgeons of these two countries have accepted with enthusiasm the invitation of our organization to affiliate themselves with it. A number of the leaders of the profession in the more important cities are now engaged in expanding the movement and are acting as Committees on Credentials in the work of adding to our membership the men of the character whom the American College of Surgeons wishes to include. It does not bespeak overconfidence to express the belief that within a short time we will have in our ranks practically all of the leading surgeons of both Republics, and while they will be numerically small they will represent the highest type of citizen. As they are men of wide influence, their action in affiliating with the College will be of great assistance in the development of good will, not only among the members of the medical profession but in far wider circles.

#### 2. *Surgeons of Ecuador and Bolivia*

The surgeons of Ecuador and Bolivia are a splendid body of men. In their profession they represent as fine a type as could be the boast of any country; they are advanced in training and methods; men of broad culture and of the gracious and hospitable manners for which cultivated gentlemen of Hispanic-American blood are noted. My experience while in charge of the Chile Exploration Company Hospital at Chuquicamata, Chile, in 1918-19, had led me to expect as much. This hospital is located in a large copper mining camp 10,000 feet up in the Andes, a day's journey from the coast. It was established by the Exploration Company, a Guggenheim corporation, to care for its people in that section. When I accepted the post I discounted somewhat the description of the hospital that was given to me and expected something rather crude; but on my arrival at the mines I found that the Guggenheims had erected a fine modern hospital which had an equipment as complete as that of any hospital to be found in the United States, this equipment involving the usual large annual deficit which seems to be essential to the success of every hospital.

The fact that this hospital was North American and new, made it an object of interest to many physicians and surgeons of Chile and neighboring countries, also to many educated laymen. They came to visit us and I began to meet and know my South American colleagues. I encountered many able men of charm and interest and was increasingly glad of every opportunity to amplify my knowledge of them. I look back with pleasure on my many pleasant social experiences with these courtly people. My contact with these visitors and our own splendid neighbors gave me a foreknowledge of the kind of men I would meet among the surgeons of Ecuador and Bolivia.

#### 3. *Reception as a Representative of the American College of Surgeons*

The movement to bring the South American surgeons into the American College of Surgeons was started in 1920, when Dr. William J. Mayo and Dr. Franklin H. Martin went to Peru, Chile, Argentine, and Uruguay. They wished also to visit Ecuador and Bolivia, but the capital of each of these countries is in the interior, not easy of access, and the journey would have taken more time than they had at their disposal. No doubt my South American expedition in behalf of the College brought me the honor of extending to the surgeons of these republics an invitation to become affiliated with the American College of Surgeons, but the mission of Dr. Mayo and Dr. Martin was not news to the men whom I met, and

in a great measure I am indebted to the pioneer work of those incomparably splendid representatives for the success with which I met. They had paved the way, and the countries which they did not visit on this initial trip were merely awaiting a formal invitation to join in the movement.

## II. Ecuador

### 1. *Quito—Señor José Gabriel Navarro*

The first city I visited was Guayaquil, the principal port of Ecuador, and from there I went to Quito, the capital. In my brief stop at Guayaquil I arranged for a meeting of the surgeons to be held on my return from Quito.

The journey to Quito by a zig-zag railway which climbs out of the tropical jungle up into the mountains is one to make an enthusiast of even the most blasé traveller. On the second day of the journey, after leaving Riobamba and approaching Quito, the route brings into view some of the highest and most beautiful peaks of the whole Andean Cordillera.

I had a wonderful guide on this journey in the person of Señor José Gabriel Navarro, Director and Founder of the College of Los Belles Artes in Quito. I was intensely interested in the information he gave me about the old Inca kingdom which formerly occupied and still lends a wonderful color to this great, high plain between the two chains of the Andes. But more than this I was heartened by the significance which he attached to my visit as indicating the kind of a reception I might expect in Quito. I was a rare kind of a visitor because I was not a tourist, I was looking for no concession, and I had nothing to sell.

### 2. *Mr. Charles Hartman—Señor Pablo A. Vascoñez—Señor Don Carlos Tobar y Borgoña*

Mr. Charles Hartman, the American Minister, is the Dean of the Diplomatic Corps of Quito and a representative of whom his country may well be proud. He treated me to some genuine American hospitality and took a real interest in my mission. Through his kindness I had the pleasure of meeting some of the charming and cultured people of the Ecuadorean capital, as fine and distinguished a group of men as it has been my good fortune to encounter anywhere.

Among the public men who interested themselves in the object of my mission were Señor Pablo A. Vascoñez, Minister of Public Instruction, and Señor Don Carlos Tobar y Borgoña, Rector of the National University. These two men are among the most distinguished educators and public men of Ecuador. The Ministry of Public Instruction is a cabinet office and I was privileged to visit with Señor Vascoñez in his Department headquarters in the historic old National Palace built in Spanish colonial times.

Señor Tobar, now Rector of the University, had but recently retired from the position of Minister of Foreign Affairs, which corresponds somewhat to the post of Secretary of State in our own cabinet. In this position he had been in almost daily contact with our Minister, Mr. Hartman, and they proved to be old friends. He was kind enough to invite me to his home and I thoroughly enjoyed an informal visit in his wonderful old-world mansion accompanied by my splendid sponsors, Señor Navarro and the American Minister. I wish that I could convey the charm I felt in the presence of Señor Tobar who is possessed of a most engaging personality. He is tall, slender, fine-looking, trained for a diplomatic career, and a man of the world in the very best sense of that description. I describe him because he epitomizes the attributes of his race. He is intensely interested in cultural and educational matters and visualized the importance of our movement from the general educational standpoint. In the course of our conversation he discussed the possibility of the Government itself sending one of the Professors of the Medical Faculty as an official representative to the next Convocation of the College.

### 3. *Preliminary Conference—Official Committee*

Although it happened to be holiday time when I arrived in Quito, Señor Tobar, in his capacity of Rector of the University, arranged to have a representative group of the Medical Faculty hold a conference with me so that I might have the privilege of explaining to them the aims and ideals of the American College of Surgeons.

This official committee was headed by Dr. Angel Saenz, Dean of the Medical Corps, a distinguished ophthalmologist and chief of the eye department, a man who has won an enviable name for himself in this part of the world. Dr. Carlos A. Serrano, Surgeon Major of the army, Dr. Eustorgio Salgado, distinguished specialist in genito-urinary surgery, and Dr. Pablo Arturo Suarez, in charge of the department of X-ray, were also members of this committee.

They did me the honor of waiting upon me in my hotel in the beautifully formal manner which is one of the charms of Hispanic-American life. They took a very serious interest in the methods of organization, the plans, and the ideals of the College. They had known of the organization only in a very general way and asked me many

Nuevo Hospital Civil de Quito, Ecuador.

questions bearing upon detail. The interest evinced even by those who were not engaged in surgery aroused in me a feeling of regret when I explained to them that membership in our ranks was open only to men of the right caliber who were engaged in surgery or one of the surgical specialties. They were keenly interested in the proposed plan of co-operation and impressed me as men of culture and discernment. The practical post-graduate results achieved by the clinics and demonstrations at the Clinical Congresses were clearly appreciated and I have no doubt that the future Convocations will be increasingly Pan-American in a more complete sense than in the past.

### *4. Nuevo Hospital Civil—Dr. Ricardo Villavicencio Ponce*

Before leaving Quito I had the pleasure of visiting the Nuevo Hospital Civil now in course of construction. Dr. Ricardo Villavicencio Ponce acted as my guide and showed me the plans for the finished structure. It is a magnificent plan which calls for the expenditure by the Government of about seven millions of dollars, and contemplates a complete hospital with all departments affiliated with the medical department of the University. Dr. Villavicencio, a graduate of the University of Brussels, is Professor of Surgery in the University. The construction is far enough advanced so that with his aid I was able to get a good idea of the contemplated structure. One of the striking features is a graceful pergola with a slightly curving double row of solid columns supporting a solarium at least a thousand feet in length. The buildings are located on an elevated site so that they overlook the city and face the beautiful Mount Pichincha across the valley. A tunnel is being constructed which will penetrate the knoll on which the hospital stands. This tunnel will pass under all of the buildings and will carry the drainage from the hospital beyond the valley in which the city lies With its beautiful location

and in this wonderful climate it should be a notable institution when it is completed.

*5. The Maternidad—Dr. Isidro Ayora*

Another fine institution in Quito is the new Maternidad, a hospital devoted to gynecology and obstetrics. It was organized by its able Director, Dr. Isidro Ayora, who is also Professor of Gynecology and Obstetrics in the University. Dr. Villavicencio and Dr. Ayora are now associated in the expansion of the work of the College in Ecuador and are worthy representatives of their country.

*6. Guayaquil—Dr. Frederick W. Goding*

Before leaving Guayaquil for the interior, having arrived between trains, which leave several times a week, I had an opportunity to look around for a few days before leaving for the capital. The pleasure of my visit to Ecuador was greatly enhanced by meeting with Dr. Frederick W. Goding, Consul-General of the United States, who has his headquarters in Guayaquil. Dr. Goding is an American physician who was peacefully practicing his profession in Illinois at the time of the Spanish-American war, when the martyred President McKinley's knowledge of his special ability along certain lines precipitated him into Government service, first in the Philippines and later in other Spanish-speaking countries. It was undoubtedly a loss to the good people of Illinois, but a gain to the consular service which needs more of the fine type of men represented by Dr. Goding. Along with his official duties he has found time to keep in touch with the world of science, and during the seven years of his stay in Ecuador he has written several monographs covering original researches made by him on the very interesting insect life of that country.

*7. Dr. Juan B. Arzube Cordero—Dr. Miguel H. Alcívar*

Through Dr. Goding I had an opportunity to become acquainted with Dr. Juan B. Arzube Cordero, Dean of the Medical Faculty and Professor of Gynecology in the local University. My meeting with Dr. Arzube was epochal as he was the first prominent member of the profession of Ecuador with whom I came in contact and his reception of me and my mission would go a long way toward demonstrating what reaction I might expect from the other members of the profession in his country. I need have had no trepidation on this score. Dr. Arzube, a splendid gentleman, would have received me courteously whatever my mission, and as it was he received me with enthusiasm. He repeated in almost as many words what the Prefect of Police had said to me when I went to his office for the formality of recovering my passport: "Your visit, Señor, is one of great significance to the medical profession of our country. It is indeed a grand idea to attempt to unite the surgeons of the two continents into one great organization so that we may profit by interchange of ideas."

Guayaquil is the seat of a University which has a complete medical department with approximately the same number of students as the Central University at Quito, that is to say between eighty and ninety. Dr. Arzube is Dean of the Faculty and Professor of Gynecology. He is of the most progressive type, and when he was apprised of the plans and hopes of the officials of the College he became deeply interested and entered into co-operation in the heartiest manner.

The first man to whom he introduced me after my return was Dr. Miguel H. Alcívar, the Professor of Surgery and perhaps the most widely known of the Ecuadorean surgeons both inside and outside of the limits of his own country. His exceptional skill and ability have brought him deserved renown. Dr. Alcívar's visits to the various clinical centers of this country and his friendship and admiration for Dr. William J. Mayo and other prominent North American surgeons whose names had been identified with the organization of the American College of Surgeons made anything that I might say quite unnecessary; he was already a strong advocate of the idea of affiliation.

I am deeply indebted to these courteous gentlemen for their aid in the accomplishment of my mission. They invited me to attend what in their country is called a "breakfast" to be given in my honor at the leading club where I might meet some of the members of the medical profession. The *almuerzo* (or "breakfast" as it is translated) is really a very elaborate course luncheon which lasts for several hours and is one of the popular methods of entertaining guests in all of the Latin-American countries. This one was served in a beautiful dining-room overlooking the water, the club being located on the Malecón, a street which runs parallel to the water-front.

The men at the luncheon were not all surgeons but they were all interested in the movement of *rapprochement* inaugurated by one of the important North American scientific bodies. I was struck by the cordiality shown to me on all sides as an American medical man. I was struck

also by their familiarity with the names of leaders of the profession in the United States. They made inquiries about the work and personalities of such men as Murphy, the Mayos, Crile, Ochsner, Cushing, and many others. The name of Gorgas is, of course, a household word in Ecuador and the feeling of gratitude engendered in the hearts of these people by the fine work of the sanitarians of the Rockefeller Institute is certainly something of which every American may well feel proud.

I felt a patriotic glow as I talked with these men, some of whom were engaged in carrying on the work that had been started by my countrymen. I realized how much the elimination of yellow fever, for instance, had benefited this city and how the appreciation of that work was now making easier the closer affiliation of our professional life. This conception of mine was strengthened when later I made a tour of the hospitals of Guayaquil. The hospitals of Guayaquil are of the tropical type of construction. They comprise all departments and are in charge of well-trained, competent men. I might say in passing that the development of nurses' training schools is one of the notable things that requires attention. However, the need of a competent nursing body is recognized and steps are being taken to remedy this defect.

### *8. General Hospital—Dr. Juan Rubio*

In the General Hospital of Guayaquil the ability and reputation of Dr. Juan Rubio have contributed to build up an ophthalmological department that is somewhat out of proportion to the size of the hospital, but which in its completeness and general arrangement gives evidence of the excellence of this talented man. Diseases of the eye seem to be very prevalent in this country, perhaps aggravated by the constant brilliant sunlight. For this reason, perhaps, I found that Dr. Rubio's service in Guayaquil, like that of Dr. Saenz in Quito, was of greater importance than would be the eye service in a university hospital of corresponding size at home.

### *9. Committee on Credentials*

I left Ecuador with regret but cheered by the reception accorded to me by the press and the public, as well as by the profession. Dr. Alcívar and Dr. Arzube of Guayaquil having agreed to co-operate with Dr. Villavicencio and Dr. Ayora of Quito in the formation of a nationally representative committee to promote the affiliation, I departed with the feeling that the future development of the College was in the hands of men who could well represent its ideals.

Dr. Miguel H. Alcívar, Professor of Operative Medicine, Faculty of Medicine of Guayaquil, Ecuador.

## III. Bolivia

### *1. LaPaz—Lake Titicaca*

It was with considerable more confidence that the approach was made to LaPaz, the capital city of Bolivia, and incidentally the highest capital in the world. Bolivia, the mediterranean country and the third in area of South America, has no seaport. There are three routes of approach to the capital, the most interesting perhaps being by way of the famous Lake Titicaca, a lake which is twelve thousand feet above sea level and is navigable for large steamers.

### *2. Mr. Samuel Abbott Maginnis—Señor Celso Lugones—Dr. Manuel Mariaca*

Mr. Samuel Abbott Maginnis, the popular American Minister to Bolivia, was sponsor for our cause in LaPaz. Through his courtesy introductions were secured to Señor Celso Lugones, Rector of the University, and Dr. Manuel Mariaca, Dean of the Medical Corps. A repetition of the same kind of interest that had been shown in

the sister republic was here manifested. Señor Lugones, who was interested in the mission from the general cultural standpoint, offered to lend the support of his official position to further our objects in every way possible. Dr. Mariaca, in his capacity as Dean, called a meeting of the surgeons and surgical specialists of the medical school faculty to confer with me. There was quick action. Our South American brethren are not always as dilatory as we have been led to believe. It was announced that the conference would be held in the Rectorate of the National University the next afternoon at four o'clock.

Señor Lugones turned over his conference rooms and there in the Rectorate of the National University of San Andrea, on February 5 at the designated hour, 4 p.m., Dr. Mariaca called together the group of leading surgeons of LaPaz to hear the message of their colleagues from North America. Dr. Mariaca who is not a surgeon then turned the meeting over to the assembled surgeons and they proceeded to organize, following the parliamentary procedure with which we are all familiar.

*3. Dr. Claudio Sanjines—Dr. Felix Veintemillas*

Dr. Claudio Sanjines, who is Professor of Surgery in the University and perhaps the most widely known surgeon in Bolivia, was elected President and Dr. Felix Veintemillas, a younger man, a nose and throat specialist, was elected Secretary. Having received the letters and credentials from the College, Dr. Sanjines welcomed me to Bolivia in the name of the surgical fraternity of that Republic and expressed the satisfaction felt by himself and his colleagues at the invitation to co-operate in the work of the College. The discussion then became general, views were exchanged quite freely, and many questions bearing upon different phases of medical organization in North America were put to me. Finally the complete and detailed plan as outlined in the letter of Dr. Franklin H. Martin, Secretary-General of the American College of Surgeons, to the surgeons of Bolivia was the subject of marked approbation, offering as it did Fellowship to their surgeons on an equal basis and governed by the same requisites as in North America. The plan of affiliation was put to a vote and passed unanimously.

*4. Committee on Credentials*

Dr. Sanjines was made President of a permanent Committee on Credentials to carry along the work of the College in Bolivia. In his speech of acceptance he again expressed his hearty approbation of the work and told of his desire to interest the surgeons in the other cities of the Republic.

*5. Interest in North American Medical Publications*

Referring to the section of Dr. Martin's letter which asked for suggestions to foment a closer relationship between the surgeons of the two continents, he stated that in the name of the surgeons of Bolivia, he would like to suggest that inasmuch as the American College of Surgeons was now Pan-American in its scope, its publications, or at least the more important ones, be translated into Spanish. Also that the College encourage the translation of our best textbooks into Spanish, as the South American surgeons are only slightly familiar with our books. He mentioned the fact that Keen's *Surgery* and Kelly's *Gynecology* had been translated and the quality of these publications had made them eager to obtain translations of more of our important works. It is a pleasant duty to transmit these messages from the surgeons of Bolivia to their colleagues in the United States and Canada and to express satisfaction at their approval of the plan of affiliation.

*6. Dr. Daniel Bilboa—Hospitals*

On the following days of my stay in LaPaz, in company with Dr. Sanjines, Dr. Veintemillas, and Dr. Daniel Bilboa, another member of the committee that had been created, I visited a number of the hospitals and private clinics. The hospital situation in LaPaz is far from satisfactory. The number of beds is inadequate, a state of affairs with which we are not unfamiliar in this country. The condition of the hospital situation is well recognized by the local profession. Many of the present hospital buildings are old and lack modern requisites for a center of this size. The Municipality has under construction a new hospital which, when finished, will contain all departments and will be a very modern and creditable institution of about seven hundred beds. It is ideally located on the outskirts of the city in a suburb well named Miraflores, which might be translated "A Vision of Flowers," the flowers of course in this latitude being in bloom throughout the year. At present this hospital has in general use about two hundred beds and a separate contagious disease department of ample capacity.

*7. Typhus Epidemic*

There had been an outbreak of typhus in and around LaPaz shortly before my arrival and I

had an opportunity to see a number of cases of this interesting disease in various stages of its progress, from the early eruption to the point of convalescence, this being my first experience with the disease which is fortunately rare in our country.

A young American surgeon of great promise, Dr. Charles Eastman, in charge of the hospital at the tin mining operations of a large American corporation, was one of the victims of this recent epidemic. As is well known, the disease is transmitted by the bite of a louse, and Dr. Eastman, in his zeal for the care of his patients and reckless of his own welfare (as Mr. Graham, the general manager of the company, told me), in order that he might better care for the Indian victims of the disease and also from a strong scientific interest in the study of the malady, often slept in the native huts which were located in remote places, exposing himself to infection without thought of himself. He is looked upon by the men who were familiar with him and with his work as a martyr to the cause of science. We have reason to be proud of the record of this fellow countryman of ours in a far land.

### *8. National Hygienic Laboratory - Dr. Nestor Morales*

The National Hygienic Laboratory of Bolivia is located at LaPaz. Its location is adjacent to the Miraflores Hospital. Under the directorship of Dr. Nestor Morales this institution has gained an enviable reputation in all of that part of South America. The various sera and vaccines which are recognized by the profession as of value in treatment and diagnosis are prepared in an excellent manner and under thorough scientific supervision in a Government laboratory, whence they are distributed.

The lack of adequate hospital facilities in Bolivia as elsewhere has been due in a large part to absence of a definite governmental policy with regard to scientific matters. As in our own country, political interference with the personnel of hospital staffs and of university faculties delays progress.

The surgeons of Bolivia have the right spirit; they have vision and ambition for the best things in scientific progress; the leading men are all young and active, they have been trained abroad, and they are cognizant of the best things in scientific progress outside of the boundaries of their own country. Under their leadership Bolivia is undoubtedly at the beginning of great accomplishments. As in Ecuador, a number of them expressed their intention of accepting the invitation to attend the next Clinical Congress to be held in Philadelphia in October of this year. The value of this affiliation and its far-reaching influence will be more evident as time goes on.

## IV. Retrospect

I look back upon my visit to Ecuador and Bolivia with great pleasure. The press and that portion of the public with whom I came in contact treated my mission as something of real importance. The newspapers in both countries attached enough significance to it to make it a matter of front-page publicity and the profession received our invitation with enthusiasm. There was the feeling of having received a genuine and cordial welcome, and I have remembrances of hours well spent in the company of courteous, warm-hearted professional colleagues. The welcome was, of course, in no sense a personal one, but a quick and hearty recognition of the hand of professional brotherhood extended to the surgeons of Ecuador and Bolivia by the surgeons of the United States and Canada. It is the beginning of a relationship which will endure to the mutual benefit of all and to the advancement of the Art.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

ELEVENTH ANNUAL SESSION, PHILADELPHIA, OCTOBER 24–28, 1921

GEORGE E. ARMSTRONG, Montreal, *President*
JOHN B. DEAVER, Philadelphia, *President-Elect* ALBERT J. OCHSNER, Chicago, *Treasurer*
FRANKLIN H. MARTIN, Chicago, *Secretary-General*

## PRELIMINARY CLINICAL PROGRAM FOR PHILADELPHIA MEETING

IN the following pages is presented a preliminary schedule of clinics and demonstrations to be given by the clinicians of Philadelphia during the eleventh annual session to be held in that city October 24 to 28, 1921. The published schedule, it will be understood, is a tentative one, and is to be amplified and corrected from month to month as the work of the Committee on Arrangements progresses, so that the final program will fully represent the clinical activities of that great medical center, providing a complete showing of Philadelphia's facilities in every department of surgery, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth, experimental surgery, surgical pathology, roentgenology, etc. The real program of the Congress, however, is that to be bulletined each afternoon at headquarters, which will present an accurate and detailed list of the operative clinics and demonstrations to be given in the several hospitals and medical schools on the succeeding day.

The general plan of previous sessions will be followed at the Philadelphia meeting—operative clinics and demonstrations in the hospitals and medical schools will occupy the morning and afternoon hours of the four days, Tuesday to Friday inclusive, with scientific meetings each evening in the ballroom ot the Bellevue-Stratford.

The Congress formally opens with the Presidential Meeting on Monday evening, at which meeting the John B. Murphy Oration in Surgery will be delivered by Dr. William J. Mayo of Rochester. The Executive Committee of the Congress, in preparing the program of papers to be read and discussed at the evening sessions, has invited a number of eminent European surgeons to read papers. Acceptances have been received from the following: Sir Harold J. Stiles, Edinburgh, Scotland; Professor H. C. Jacobaeus, Stockholm, Sweden; Professor J. Schoemaker, The Hague, Holland; Professor F. de Quervain, Berne, Switzerland, and Sir William Taylor, Dublin, Ireland.

General headquarters for the Congress will be at the Bellevue-Stratford Hotel where the entire first floor has been reserved for the use of the Congress. The large ballroom will be utilized for the evening sessions, certain clinical demonstrations, business meetings, etc, while the Clover, Red, Green, and other large rooms and foyers on the same floor will provide ample space for registration and ticket bureaus, bulletin rooms, etc. Headquarters will be open for registration at noon, Monday, October 24th. The clinical program for Tuesday will be bulletined at headquarters that afternoon, and tickets for Tuesday's clinics will be issued as visiting surgeons register.

The ninth annual convocation of the American College of Surgeons will be held in the ballroom on Friday evening at 8 o'clock, at which time fellowship in the College will be conferred upon a large group of American and Canadian surgeons, and honorary fellowship upon the distinguished foreign guests.

The annual business meeting of the American College of Surgeons and the Clinical Congress will be held on Thursday afternoon.

### REDUCED RAILWAY FARES

The railways of the United States have, with but few exceptions, granted reduced rates for the Philadelphia meeting, and it is expected that the Canadian railways will join in the arrangement. The plan provides for the sale of round-

trip tickets at one and one-half the ordinary one-way fare. These tickets will be sold to members upon presentation of identification certificates issued from the office of the Secretary-General. Further detailed information with regard to fares and traffic arrangements will be published in the next issue of this journal.

LIMITED ATTENDANCE — ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting the attendance, requiring registration in advance on the part of those who wish to attend. A survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools, as to their capacity for accommodating visitors, has been made and the limit of attendance based thereon.

CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, the number of tickets issued for any clinic or demonstration being limited to the capacity of the room in which the clinic or demonstration is to be given.

Clinic tickets will be issued at headquarters each morning at 8 o'clock for the clinics and demonstrations to be given that day, except that for Tuesday's clinics the tickets will be issued on Monday afternoon as the visiting surgeons register. Each afternoon a complete schedule of the following day's clinics will be posted on bulletin boards at headquarters. After the program has been posted, reservations for tickets for the clinics may be filed, the tickets to be issued the following morning. Printed programs will be issued each morning containing the complete clinical program for the day with announcements of the evening sessions, business meetings, etc.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, the receipts from registration fees providing the funds with which to meet the expenses of conducting the meeting, so that no financial burden is imposed upon the members of the profession in the city entertaining the Congress.

A formal receipt for the registration fee is issued to each surgeon registering in advance, which receipt is to be exchanged for a general admission card at headquarters upon his arrival in Philadelphia. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings.

## PRELIMINARY CLINICAL PROGRAM

### POLYCLINIC HOSPITAL

*Tuesday, October 25*

DEFOREST WILLARD—10. Orthopedics.
E. A. CASE—11. Surgical pathology.
G. M. PIERSOL and DR. BACHUS—12. Gastro enterology.
GEORGE B. WOOD—2. Nose and throat.
T. WEISENBERG—2. Neurology.
J. F. SCHAMBERG—3. Salvarsan clinic.

*Wednesday, October 26*

J. K. YOUNG—10. Orthopedics.
MISS H. E. KIRCH—11. Social service.
J. A. KOLMER and J. K. YOUNG—1. Demonstrations of research work in connection with the manufacture of salvarsan.
RALPH BUTLER—2. Nose and throat.

*Thursday, October 27*

E. A. CASE—9. Surgical pathology.
MRS. M. S. STEEL—10. Speech clinic.
WALTER ELMER—11. Orthopedics.
B. A. THOMAS—2. Genito-urinary surgery.
GEORGE B. WOOD—2. Nose and throat.

*Friday, October 28*

J. K. YOUNG and DEFOREST WILLARD—10. Orthopedics.
RALPH BUTLER—2. Nose and throat.
J. C. GITTINGS—2. Pediatrics.

### LANKENAU HOSPITAL

*Tuesday, October 25*

V. G. MILLER and ROBERT SHOEMAKER—10. X Ray clinic for fractures and joint injuries.

*Wednesday, October 26*

JOHN B. DEAVER, GEORGE G. ROSS, and A. D. WHITING—9. General surgery.

*Thursday, October 27*

JOHN B. DEAVER, GEORGE G. ROSS, and A. D. WHITING—9. General surgery.

*Friday, October 28*

A. G. MILLER and ROBERT SHOEMAKER—10. Fractures and joint injuries.

### ORTHOPEDIC HOSPITAL

*Tuesday, October 25*

A. P. C. ASHHURST and EDWARD T. CROSSAN—3. Demonstrations: tarsectomy for rigid flat foot, inveterate club foot, and equinocavus; birth injuries of shoulders; lacerations of brachial plexus.

*Thursday, October 27*

A. BRUCE GILL—10. Orthopedics.

*Friday, October 28*

WILLIAM J. TAYLOR—10. Orthopedics.

## PENNSYLVANIA HOSPITAL

*Tuesday, October 25*

W. D. Stroud—10. Electrocardiogram.
Dr. MacMillan—10. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
Drs. LeConte, Lee, and Brown—11. General surgery.
L. J. Herman—1. Genito-urinary surgery.
E. A. Strecker—1. Neurology.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
Drs. Shoemaker and Crampton—2. Eye clinic.

*Wednesday, October 26*

W. D. Stroud—10. Electrocardiogram.
Dr. MacMillan—10. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
G. W. Norris—10. Medical clinic.
Drs. Gibbon, Billings, and Klopp—11. General surgery.
Drs. Shoemaker and Crampton—2. Eye clinic.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
F. C. Knowles—2. Skin.

*Thursday, October 27*

W. D. Stroud—10. Electrocardiogram.
Dr. MacMillan—10. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
A. Newlin—10. Medical clinic.
Drs. Mitchell, Lee, and Brown—11. General surgery.
L. J. Herman—1. Genito-urinary surgery.
Drs. Newcomer, Davis, and Knowles—2. Syphilis-Salvarsan.
E. A. Strecker—2. Neurology.
Drs. Shoemaker and Crampton—2. Eye clinic.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.

*Friday, October 28*

W. D. Stroud—10. Electrocardiogram.
Dr. MacMillan—10. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
T. McCrae—10. Medical clinic.
Drs. Gibbon, Billings, and Klopp—11. General surgery.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
Drs. Shoemaker and Crampton—2. Eye clinic.

## METHODIST HOSPITAL

*Tuesday, October 25*

William R. Nicholson—9. Gynecology.
J. H. Baldwin—11. General surgery.
Walter Roberts—1. Nose and throat.
Philip H. Moore—2. Eye clinic.
M. I. Pincoffs—[illegible] Roentgenology.

*Wednesday, October 26*

G. G. Ross—9. General surgery.

*Thursday, October 27*

Richard Norris—2. Gynecology and obstetrics.

*Friday, October 2*

J. L. Herman—12. Genito-urinary surgery.
I. J. Hammond—[illegible] General surgery.
J. T. Rugh—3. Orthopedics.

## UNIVERSITY HOSPITAL

*Tuesday, October 25*

B. C. Hirst and J. C. Hirst, II—9. Gynecology and obstetrics.
C. C. Norris and F. E. Keene—9. Gynecology.
George Ross—9. Hernia clinic.
Alfred Stengel and staff—12. Medical cases with surgical aspects.

*Wednesday, October 26*

Charles H. Frazier and Francis Grant—9. Operations and demonstrations; surgery of nervous system.
F. E. Keene and C. C. Norris—9. Gynecology.
D. B. Pfeiffer—9. General surgery.
Thomas Neilson and Allen Randall—11. Urology.
Henry Pancoast—3. Roentgenological demonstrations.

*Thursday, October 27*

B. C. Hirst, E. B. Piper, and J. C. Hirst, II—9. Gynecological and obstetrical operations and demonstrations.
George P. Muller—9. Surgery of the chest.
C. C. Norris and F. E. Keene—9. Gynecology.
C. H. Frazier and Francis Grant—9:30. Neurological surgery, operations and demonstrations.

*Friday, October 28*

F. E. Keene and C. C. Norris—9. Gynecology.
C. H. Frazier and Francis Grant—9:30. Neurological surgery, operations and demonstrations.
John B. Deaver—10. General surgery, operations.
Charles P. Grayson—2. Nose and throat.
Henry Pancoast—3. Roentgenological demonstrations.

## HOWARD HOSPITAL

*Tuesday, October 25*

A. C. Wood—9. General surgery.
E. L. Eliason—11. General surgery.
George B. Wood—1. Nose and throat.
R. J. Hunter and S. Cohen—2. Nose and throat operations (tonsillectomy).

*Wednesday, October 26*

Bernard Mann—9. Gynecology.
Barton Cooke Hirst—11. Gynecology.
W. C. Posey—2. Eye clinic.

*Thursday, October 27*

A. C. Wood—9. General surgery.
E. L. Eliason—11. General surgery.
George B. Wood—2. Nose and throat

*Friday, October 2[illegible]*

Bernard Mann—9. Gynecology.
Barton Cooke Hirst—11. Gynecology.
W. C. Posey—2. Eye clinic.

## CHILDREN'S HOSPITAL, MARY J. DREXEL HOME

*Tuesday, October 25*

N. L. Knipe—2. Eye operations.

*Wednesday, October 26*

Ralph Butler—2. Mastoid operations.

*Thursday, October 27*

James N. Bartlett—Tonsil and adenoid operations.

*Friday, October 2[illegible]*

H. C. Deaver and E. G. Alexander—10:30. General surgery.

## MEDICO-CHIRURGICAL HOSPITAL

*Tuesday, October 25*

GEORGE P. MULLER—9. General surgery.
JOHN A. KOLMER. Demonstration—frozen section work.
GEORGE COATES and MATTHEW ERSNER. Demonstration—nose and throat cases.
W. H. MACKINNEY—10. Genito-urinary surgery.
GEORGE COATES and MATTHEW ERSNER—2. Nose and throat.
I. S. RAVDIN—3. Demonstration—postoperative cases of compound fractures.
J. F. JAFFEE—3:30. Gynecological models.
T. T. THOMAS—4. Demonstration—operation for recurrent dislocation of shoulder.

*Wednesday, October 26*

J. H. JOPSON—9. General surgery.
W. R. NICHOLSON—9. Gynecology.
L. WEBSTER FOX—2. Eye clinic.
R. H. SKILLERN—2. Sinus clinic.
T. T. THOMAS—3. Recurrent dislocation of shoulder.
WILLIAM BATES—4. Demonstration of fractures.

*Thursday, October 27*

E. LAPLACE—9. Surgical clinic and demonstrations.
R. F. RIDPATH—10. Demonstration of sinus cases.
G. E. PFAHLER—2. Electro coagulation clinic with demonstration of cases.
MORRIS B. MILLER—3. Demonstration of cases of cervical adenitis treated with tuberculin.

*Friday, October 28*

J. B. CARNETT—9. General surgery.
G. M. BOYD—9. Gynecology.
GEORGE COATES, M. ERSNER, R. H. SKILLERN, and R. F. RIDPATH—2. Tonsillectomies.
H. MCKNIGHT—2. Demonstration of interesting fractures.

## JEFFERSON HOSPITAL

(Days and hours to be announced)

J. CHALMERS DACOSTA. General surgery.
JOHN H. GIBBON. General surgery.
S. MACCUEN SMITH. Ear, nose, and throat.
BROOKE M. ANSPACH. Gynecology.
CHEVALIER JACKSON. Laryngology.
E. P. DAVIS. Gynecology.
WILLIS F. MANGES. Roentgenology.
J. TORRANCE RUGH. Orthopedics.
H. F. HANSELL. Eye clinic.
H. R. LOUX. Genito-urinary surgery.

## STETSON HOSPITAL

*Tuesday, October 25*

B. M. ANSPACH—8. Gynecology.
W. K. NEELY—9. Obstetrics.

*Wednesday, October 26*

S. E. TRACY—9. Gynecology.
CARL LEE FELT—1. Laryngology.

*Thursday, October 27*

J. A. BOGER and W. ELLIS—8. General surgery
W. K. NEELY—9. Obstetrics.

*Friday, October 28*

S. E. TRACY—9. Gynecology.
CARL LEE FELT—1. Laryngology.

## PROTESTANT EPISCOPAL HOSPITAL

*Tuesday, October 25*

A. P. C. ASHHURST and I. M. BOYKIN—9. General surgery.
LOUIS H. MUTSCHLER—11. General surgery.
G. ORAM RING—3. Eye operations.

*Wednesday, October 26*

A. BRUCE GILL—9. Orthopedic operations.
H. G. GOLDBERG—2. Eye operations—cataract.
J. P. GALLAGHER and E. COLLINS—3. Ear, nose, and throat (ethmoid).

*Thursday, October 27*

H. C. DEAVER and E. G. ALEXANDER—10. General surgery.
T. R. NEILSON—11. General surgery.
CHARLES C. BIEDERT and T. R. CURRIE—2. Ear, nose, and throat operations.

*Friday, October 28*

A. P. C. ASHHURST and EDWARD T. CROSSAN—9. General surgery.
A. P. C. ASHHURST and RALPH S. BROMER—2. Dry bone clinic (cystic disease and sarcoma).

## ST. AGNES' HOSPITAL

G. M. DORRANCE and LOWRAIN E. MCCRAE—Plastic operations on the face and neck. Cases showing the results of operations.
J. W. BRANSFIELD—Treatment of burns by the use of acetic acid method.
E. C. MURPHY—Application of Whitman's cast.
JOHN F. X. JONES and W. J. RYAN—Demonstrations of fractures and hernias.
J. C. HIRST—Prolapse of the uterus.
BENJAMIN D. PARRISH—Demonstration of sinus cases with tonsillectomy by the LaForce method, local and general anæsthesia; demonstration of mastoid cases with indications for each.
J. P. MANN—Demonstration of cases with operation for diseases of the hip joint.
ALFRED HEINEBERG—Uterine endoscopy.
JOHN M. FISHER—Repair of pelvic floor; amputation of cervix; hysterectomy for fibroids of the uterus; hysterectomy for carcinoma of the uterus; operative correction for displacements of the uterus; operations in cases of pelvic inflammatory diseases.

## PHILADELPHIA GENERAL HOSPITAL

*Tuesday, October 25*

H. R. LOUX—9. General surgery.
J. T. RUGH—2. Orthopedics.
M. M. FRANKLIN—3:30. Orthopedics.

*Wednesday, October 26*

T. T. THOMAS—9. General surgery.
F. O. LEWIS—3:30. Laryngology.

*Thursday, October 27*

JOHN FISHER—9. Gynecology.
J. C. HIRST—10:30. Gynecology.

*Friday, October 28*

H. R. OWEN—9. General surgery.
E. R. KIRBY—2. Genito-urinary surgery.
R. H. IVY—3:30. Oral surgery.

## MISERICORDIA HOSPITAL

*Tuesday, October 25*

JAMES A. KELLY and E. LAPLACE—9. General surgery, operative clinic.
CORNELIUS MCCARTHY—2. Nose and throat.

*Wednesday, October 26*

J. F. X. JONES—9. General surgery, operative clinic.
GEORGE P. MULLER—9. General surgery, operative clinic.
THOMAS F. BYRNE—2. Nose and throat.

*Thursday, October 27*

JAMES A. KELLY—9. General surgery, operative clinic.
ERNEST LAPLACE—9. General surgery, operative clinic.

*Friday, October 28*

J. F. X. JONES—9. General surgery, operative clinic.
GEORGE P. MULLER—9. General surgery, operative clinic.
LOUIS LOVE—2. Ophthalmology.

## KENSINGTON HOSPITAL FOR WOMEN

*Tuesday, October 25*

E. G. ALEXANDER—11. Gynecology.

*Wednesday, October 26*

H. C. DEAVER—11. Gynecology.

*Thursday, October 27*

DANIEL LOVE MILLER—11. Obstetrics.

*Friday, October 28*

W. H. PAREL—11. Gynecology.

## ST. CHRISTOPHER'S HOSPITAL

*Tuesday, October 25*

R. R. WILLOUGHBY—10:30. Tonsil and adenoid operations.

*Wednesday, October 26*

E. G. ALEXANDER—10:30. General surgery.
ROBERT GRAY—1. Orthopedic operations.

*Thursday, October 27*

DR. ADAMS—10:30. Operative eye clinic.
FREDERICK KEATSE—3. Mastoid clinic.

*Friday, October 28*

C. A. CURRIE—10:30. Tonsil and adenoid operations.

## WOMEN'S HOSPITAL

*Tuesday, October 25*

MARIE K. FORMAD—9. Gynecology.
SARAH H. LOCKREY—11. Gynecology.
LIDA STEWART COGILL—2. Obstetrics.
LAURA EMMA HUNT—2. Throat, nose, and ear.

*Wednesday, October 26*

KATE W. BALDWIN—8:30. General surgery.
CAROLINE PURNELL—11. Gynecology.
MARGARET WARLOW—2. Nose, throat, and ear.
MARY GUTTY—3. Eye clinic.
MARY BUCHANAN—4. Eye clinic.

*Thursday, October 27*

CATHARINE MACFARLANE—9:30. Gynecology.
MARY THOMAS MILLER—11. Obstetrics.

*Friday, October 28*

ANN TOMKINS GIBSON—9. Obstetrics.
ELLA WILLIAMS GUMMEY—11. Obstetrics.
MIRIAM BUTT—3. Eye clinic.

## PRESBYTERIAN HOSPITAL

*Tuesday, October 25*

J. H. JOPSON and D. B. PFEIFFER—9. General surgery.
J. H. GIRVIN—1. Gynecology.
A. B. GILL—3. Orthopedics.

*Wednesday, October 26*

G. E. SHOEMAKER—9. Gynecology.
B. A. THOMAS—2. Urology.

*Thursday, October 2*

JOHN SPEESE, J. S. RODMAN, and H. P. BROWN—9. General surgery.

*Friday, October 28*

J. H. JOPSON—9. General surgery.
N. P. STAUFFER—2. Nose and throat.

## ST. JOSEPH'S HOSPITAL

*Tuesday, October 25*

JOSEPH M. SPELLISY—10. Orthopedics.
JOHN F. X. JONES—11. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—1. Gynecology.
GEORGE E. MORLEY MARSHALL and WILLIAM E. QUICKSALL—1. Otology and laryngology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—1. Ophthalmology.

*Wednesday, October 26*

JAMES A. KELLY—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—1. Gynecology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—1. Ophthalmology.
GEORGE E. MORLEY MARSHALL and WILLIAM E. QUICKSALL—1. Otology and laryngology.

*Thursday, October 27*

MELVIN M. FRANKLIN—9. General surgery.

*Friday, October 28*

CHARLES F. NASSAU—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—1. Gynecology.
GEORGE E. MORLEY MARSHALL and WILLIAM E. QUICKSALL—1. Otology and laryngology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—1. Ophthalmology.

## SAMARITAN HOSPITAL

*Tuesday, October 25*

W. WAYNE BABCOCK—9. General surgery.
WILMER KRUSEN—12. Gynecology.
LUTHER PETTY—2. Ophthalmology.
HARRY HUDSON—3. Orthopedics.
G. C. BIRD—4. X-Ray demonstrations.

*Wednesday, October 26*

J. C. APPLEGATE—11. Obstetrics.
FRANK HAMMOND—12. Gynecology.
WILLIAM A. STEELE—2. General surgery.
COLLIER MARTIN—3. Rectal surgery.

*Thursday, October 27*

W. WAYNE BABCOCK—9. General surgery.

*Friday, October 28*

J. O. ARNOLD—12. Obstetrics.
WILLIAM A. HITSCHLER—3. Ear, nose and throat.
HERSHEY THOMAS—3. Genito-urinary surgery.

## MOUNT SINAI HOSPITAL

*Tuesday, October 25*

J. C. HIRST—9. Gynecology.
GEORGE ROSENBAUM—11. X-Ray demonstrations.
A. WATSON—2. Nose and throat operations.
C. W. LEFEVER—4. Eye operations.

*Wednesday, October 26*

M. BEHREND—9. General surgery.
L. FISHER—2. Nose and throat operations.
A. I. RUBENSTONE—2. Surgical pathology and blood transfusion.
C. S. HIRSCH—4. Genito-urinary surgery.

*Thursday, October 27*

L. BRINKMAN—9. Gynecology.
GEORGE ROSENBAUM—11. X-Ray demonstrations.

*Friday, October 28*

J. C. HIRST—9. Gynecology.
M. BEHREND—11. General surgery.
L. FISHER—2. Nose and throat operations.
S. J. GITTELSON—3. Eye operations.
A. I. RUBENSTONE—4. Surgical pathology and blood transfusion.

## JEWISH HOSPITAL

*Tuesday, October 25*

W. H. TELLER—9. General surgery.
E. STEINFIELD—10. Serology and bacteriology.
H. M. GODDARD—2. Rhinology.
S. L. FELDSTEIN—2. Roentgenology.
C. S. HIRSCH—2. Urology.

*Wednesday, October 26*

F. B. BLOCK—9. Pelvic surgery.
A. REISS—12. Electrotherapy.
S. F. FELDSTEIN—2. Roentgenology.
C. STAMM—2. Obstetrics.
A. W. WATSON—3. Rhinology.

*Thursday, October 27*

M. BEHREND—9. General surgery.
E. STEINFIELD—10. Serology and bacteriology.

*Friday, October 28*

L. BRINKMAN—9. General surgery.
S. L. FELDSTEIN—2. Roentgenology.
G. W. SHOLLER—2:30. Gynecology.
C. S. HIRSCH—4. Cystoscopy and urology.

## WOMEN'S HOMEOPATHIC HOSPITAL

*Tuesday, October 25*

DRS. W. E. STRONG, ROCHESTER, and HARTLEY—10. General surgery.
J. A. BROOKE—1. Obstetrics.

*Wednesday, October 26*

L. T. ASHCRAFT—10. Urology.
W. C. BARKER—1. Roentgenology.

*Thursday, October 27*

DRS. PAIN, CLAY, and CRISWELL—10. Eye, ear, nose, and throat.

*Friday, October 28*

DRS. CALEY, HUGHES, and D. B. JAMES, JR.—10. Gynecology.
DRS. BROOKE and LARER—1. Orthopedics.

## HAHNEMANN HOSPITAL

*Tuesday, October 25*

H. L. NORTHROP—9. General surgery.
N. F. LANE and W. D. CULIN—9. Gynecology.
W. W. SPEAKMAN and F. O. NAGLE—2. Eye clinic.
W. G. SCHMIDT—2. Hydrogen-ion concentration.
J. S. HEPBURN—3:30. Blood chemistry.

*Wednesday, October 26*

G. A. VAN LENNEP—9. General surgery.
J. E. JAMES, JR.—9. Prenatal care.
G. J. PALEN and J. V. F. CLAY—2. Ear clinic.
J. D. ELLIOIT—2. Surgical pathology.
S. W. SAPPINGTON—3:30. Basal metabolism.

*Thursday, October 27*

H. P. LEOPOLD—9. General surgery.
D. B. JAMES—9. Gynecology.

*Friday, October 28*

L. T. ASHCRAFT—9. Urology.
W. C. MERCER—9. Obstetrics.
F. W. SMITH—2. Bronchoscopy and tracheoscopy.
OSCAR SEELEY—2. Œsophagoscopy.

## WOMEN'S MEDICAL COLLEGE

*Tuesday, October 25*

E. G. ALEXANDER—11. General surgery.
MARGARET F. BUTLER—2. Rhinology and laryngology.

*Wednesday, October 26*

ELLA B. EVERITT—9. Gynecology.
MARY BUCHANAN—3. Ophthalmology.

*Thursday, October 27*

ELLA B. EVERITT—9. Gynecology.

*Friday, October 28*

HARRY C. DEAVER—11. General surgery.

## ST. LUKE'S HOSPITAL

*Tuesday, October 25*

DESIDERIO ROMAN—9. General surgery.
O. F. BARTHMAIER and J. W. POST—2. Group study of the thyroid: laboratory, roentgenology, surgery.

*Friday, October 28*

DESIDERIO ROMAN—9. General surgery.
I. G. SHALLCROSS—11. Eye clinic.
J. W. POST—2. Roentgenological study of chronic arthritis as a basis for differential diagnosis and etiology.

## CHILDREN'S HOMEOPATHIC HOSPITAL

*Tuesday, October 25*

H. P. LEOPOLD—11. General surgery.

*Wednesday, October 26*

BAYARD KNERR—11. Nose and throat.
F. W. SMITH, OSCAR SEELEY, and O. F. BARTHMAIER—2. Pathological studies.

*Thursday, October 27*

JOHN A. BROOKE—1. Orthopedics.

# STATE CLINICAL MEETINGS HELD IN JUNE

## NORTH DAKOTA—BISMARCK

FRIDAY, JUNE 24

*Clinics*

At the Bismarck and St. Alexius Hospitals, 8 a.m. to 12 m.

*Hospital Conference, 2 p.m.*

Eric P. Quain, M.D., Chairman, North Dakota Section, presiding.
Summary of Work in Hospital Standardization by the American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Soul of Hospital Standardization—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.
The Surveyor's Work in the Standardization of Hospitals—Thaddeus E. Allen of the American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—J. O. Arnson, M.D., Bismarck.
Experience with the Standardization Program of the American College of Surgeons, from the Hospital Superintendent's Standpoint—A. O. Fonkalsrud, Ph. D., Superintendent, St. Luke's Hospital, Fargo.
Discussion—Opened by R. D. Campbell, M.D., Grand Forks; continued by A. J. McCannel, M.D., Minot.
General Discussion.

*Public Meeting, 8 p.m.*

Eric P. Quain, M.D., Chairman, North Dakota Section, presiding.
Address of Welcome—Judge A. M. Christianson, North Dakota Supreme Court.
The American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Woman of Slender, Frail Physique. How May We Solve This Problem?—Richard R. Smith, M. D., Grand Rapids, Mich.
Cancer of the Breast: Its Early Recognition and Treatment—Jabez N. Jackson, M.D., Kansas City, Mo.
The Surgeon and the Public—A. T. Mann, M.D., Associate Professor of Surgery, University of Minnesota Medical School, Minneapolis, Minn.
The Community's Interest in Hospitals—Reverend C. B. Moulinier, S. J., President, Catholic Hospital Association.

SATURDAY, JUNE 25

*Clinics*

At the Bismarck and St. Alexius Hospitals, 8 a.m. to 12 m.

*Scientific Session, 2 p.m.*

Eric P. Quain, M.D., Chairman, North Dakota Section, presiding.
The Care of the Surgical Case Before It is Attended by the Surgeon—J. W. Bowen, M.D., Dickinson.
Hernia: Methods for Difficult Cases—A. T. Mann, M.D., Minneapolis, Minn.
Direct Laryngoscopy, Bronchoscopy, and Œsophagoscopy, with Report of Cases—Archibald D. McCannel, M.D., Minot.
Cystocele and Urethrocele and Their Surgical Treatment—Richard R. Smith, M.D., Grand Rapids, Mich.
Chronic Cholecystitis—R. E. Weible, M.D., Fargo.
The Comparative Anatomy of the Fundus Oculi—J. H. Rindlaub, M.D., Fargo.
Technique of the Proper Operation for Cancer of the Breast—Jabez N. Jackson, M.D., Kansas City, Mo.

## SOUTH DAKOT—ABERDEEN

MONDAY, JUNE 27

*Clinics*

At the Lincoln and St. Luke's Hospitals, 8 a.m. to 12 m.

*Hospital Conference, 2 p.m.*

Robert D. Alway, M.D., Chairman, South Dakota Section, presiding.
Summary of Work in Hospital Standardization by the American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Soul of Hospital Standardization—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.
The Surveyor's Work in the Standardization of Hospitals—Thaddeus E. Allen of the American College of Surgeons.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—Gilbert Geoffrey Cottam, M.D., Sioux Falls.
Discussion—Opened by Frederick A. Spafford, M.D., Flandreau.
General Discussion.

*Public Meeting, 8 p.m.*

The American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Woman of Slender, Frail Physique. How May We Solve This Problem?—Richard R. Smith, M.D., Grand Rapids, Mich.
Cancer of the Breast: Its Early Recognition and Treatment—Jabez N. Jackson, M.D., Kansas City, Mo.
The Surgeon and the Public—A. T. Mann, M.D., Associate Professor of Surgery, University of Minnesota Medical School, Minneapolis, Minn.
The Community's Interest in Hospitals—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.

TUESDAY, JUNE 28

*Clinics*

At the Lincoln and St. Luke's Hospitals, 8 a.m. to 12 m.

*Scientific Session, 2 p.m.*

The Reparative Surgery of Post-Traumatic Bone Defects—Gilbert Geoffrey Cottam, M.D., Sioux Falls.
Hernia: Methods for Difficult Cases—A. T. Mann, M.D., Minneapolis, Minn.
Cystocele and Urethrocele and Their Surgical Treatment—Richard R. Smith, M.D., Grand Rapids, Mich.
Osteomyelitis—F. W. Minty, M.D., Rapid City.
Technique of the Proper Operation for Cancer of the Breast—Jabez N. Jackson, M. D., Kansas City, Mo.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XXXIII SEPTEMBER, 1921 NUMBER 3

# MOBILIZATION OF THE ELBOW BY FREE FASCIA TRANSPLANTATION WITH REPORT OF THIRTY-ONE CASES[1]

BY W. RUSSELL MACAUSLAND, M.D., BOSTON
Surgeon-in-Chief, Orthopedic Department, Carney Hospital

IN a previous paper (38), read before the Orthopedic Section of the American Medical Association on June 23, 1914, I reported 4 cases in which I had gained mobility in ankylosed elbow-joints by means of arthroplasty. In 2 of these, I used the Murphy method interposing pedunculated flaps of fat and fascia; in 2, free flaps of fascia lata. At the same time, I gave a résumé of the literature on previous attempts at mobilization in this joint. I should now like to consider briefly the contributions which have been made to date to the literature on this subject and also to report my arthroplasties in full.

Ankylosis of the elbow results either from an infectious process or from traumatism. The latter is usually a fracture dislocation with wide separation. The large amount of callus which forms as a result of this injury at first interferes mechanically with motion; later, an ankylosis results, usually fibrous in character.

The infectious process may be either acute or chronic. In the former case, the causative agent is usually the streptococcus, the pneumococcus, or the gonococcus. The onset is sudden and the course severe, ending usually in a bony ankylosis.

We may, on the other hand, have a slow, insidious, polyarthritic process. The focus of infection is situated elsewhere, and the joint condition is caused by the hæmatogenous deposits in the joint, either of attenuated bacteria or of toxins. The primary focus is often difficult to locate. The ankylosis results from adhesions both within and without the joint and is, at least at first, fibrous.

In the problem of treatment of any ankylosis, the location of the joint has to be considered. In the elbow, conditions are different from those in any other of the large joints. In the lower extremity, stability is far more important than motion. Here, particularly at the knee, a firm, painless joint in good position is far more useful than a wabbly one continually subject to strains and wrenches. In a shoulder ankylosed in an abducted position, a useful degree of motion may be had by the resulting hypermobility of the scapula. A stiff wrist in a good position, i.e., hyperextension, is serviceable; moreover, as structures here are complicated, the joint does not lend itself readily to arthroplasty. In the elbow, on the other hand, no position of ankylosis is favorable to function and any position is ungainly.

Many methods have been tried to gain mobility in the elbow. Various nonabsorbable materials have been used. Gluck and others inserted ivory pegs; Pupovac, magnesium sheets, and other metals. Besides these, wood, celluloid, gutta percha, and temporary packings of gauze have been used. Taylor (67) advocated a mixture of yellow wax and lanolin.

[1] Read before the Southern Medical Association, November 15, 1920

Widely varying organic substances have been tried. Rechet (57) covered the ends of the resected bones with periosteal flaps in various joints. Hofmann (32), in 1906, reported a case in which he transplanted periosteal flaps from the tibia to the resected end of the bones of the elbow. He obtained full extension and flexion to 80 degrees.

Weglowski (74) reported a case in which he used successfully cartilage transplanted from the rib in an ankylosed elbow.

Von Frisch (23) used periosteal grafts from the tibia in an elbow ankylosed from gonorrhœal arthritis. Only 25 degrees motion was obtained. The author attributed the result to lack of after-treatment.

Herzberg (30) reported 4 cases in which transplantation of joints was done after resection. Ankylosis was the result of trauma. Three of the cases were children.

Greiffenhagen (26) reported 3 cases in which periosteum was used in elbow-joints.

Mauclair (39) used cartilage from the astragalus to cover the rough ends. X-ray later showed these fused to the bone.

More recently, cartilage grafts were used by Delangenière (16) after a resection had been done. The operation showed no advantage over an excision, as some instability of the joint followed. These methods have now been abandoned.

Excision has a few advocates but, except for this, arthroplasty has succeeded all other methods. The first case reported is that of Verneriel (72) in 1860. He gained motion by the use of a flap of muscle and fascia, interposed after resection of an ankylosed jaw. Helfereich's (28) report, however, in 1893 brought the matter to more general attention. He also used a muscle flap for interposition.

Albarran (1) reported a case in which ankylosis had followed operative reposition. A partial resection was then done by which a good immediate result was obtained but later ankylosis again occurred. A third operation was undertaken which consisted of a resection of the olecranon and interposition of a muscle fascia flap of the triceps. After two years, there was a range of motion from 65 to 115 degrees. Extension was possible without the aid of gravity. Pronation and supination were normal. There was no lateral motion.

Nélaton (45), in a case of ankylosis following a neisserian infection, resected an elbow and interposed a flap of the brachialis anticus. Two years after the operation, flexion and extension were normal, but pronation and supination were much decreased. Active extension required the weight of gravity.

In 1903, Quénu (56, b) reported an arthroplasty of the elbow for an ankylosis following a severe trauma of the arm, consisting of a fracture of both bones of the forearm and destruction of the soft parts. After resection, he interposed a tendon fascia flap. There resulted flexion to a right angle and good but incomplete extension. There was good pronation but difficulty in maintaining an intermediate position. The patient died a few months after the operation of pulmonary tuberculosis.

Delbet (17) also reported mobilizing an elbow in a girl of six, which had become ankylosed in infancy, resulting in complete atrophy of the arm. At his first operation, he resected the joint without breaking up the ankylosis. Two months later after re-ankylosis, he intervened again, removing the bony spicules that had formed, 0.5 centimeter thick, from the humerus, the radius, and the ulna, and interposing some fibers of the flexor carpi ulnaris. Chloroform mobilization was necessary a month later but the final result was good, with flexion to a right angle and extension nearly complete.

Berger (7), in the same year, mobilized a fibrous ankylosis by remodeling the bony parts and inserting a flap of the anconeus which he sutured to the brachialis anticus. He had not at the time of his report obtained active motion.

Schanz (62), in 1904, reported a mobilization of a bony ankylosis following rheumatism. After chiseling through the joint, he enlarged the sigmoid fossa, removed a piece of the trochlea, and interposed a flap of fat from the under side of the forearm. Three months after the operation, the arm could be used for ordinary purposes.

Murphy (43,a) first used his fascia method October, 1901, on a knee-joint. A large layer of fascia lata with a thin layer of muscle tissue attached was dissected from the outer surface of the vastus externus, with its base below and anterior. A small flap of fascia covering the vastus internus was dissected free and placed between the patella and the femur. He first mobilized the elbow by this method in 1904 in a case of ankylosing arthritis. A pyriform flap of deep fascia was dissected from the posterior surface of the triceps. The flap was 4½ inches long by 2 inches wide at its upper end and received its blood supply from a broad pedicle which remained attached to the muscle and fascia just below the level of the olecranon. After the bony parts had been remodeled, the fascia was drawn down and turned into the joint around the inner margin of the olecranon. The proximal portion of the flap covered the trochlea, lined the olecranon depression and the lesser sigmoid cavity, while the distal portion covered the external condyle. Subsequent events showed that the flap was not carried sufficiently high on the anterior surface of the humerus to permit adequate flexion of the joint. Five months later, the patient could pass his hand through an arc of 5 inches. Pronation and supination were about one-half normal. His second case was reported 2 months after operation. The hand could be moved actively

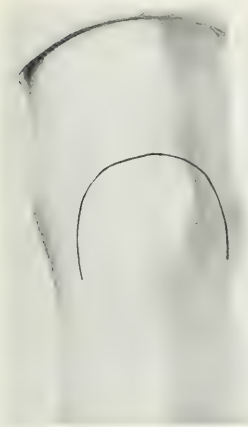

Fig. 1.

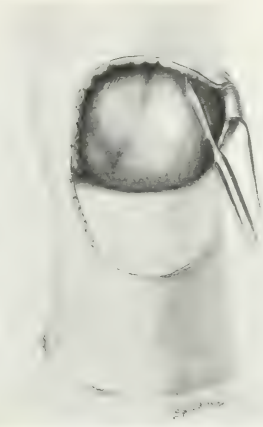

Fig. 2

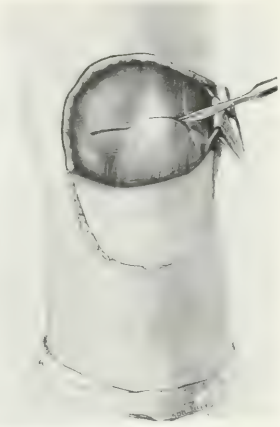

Fig. 3.

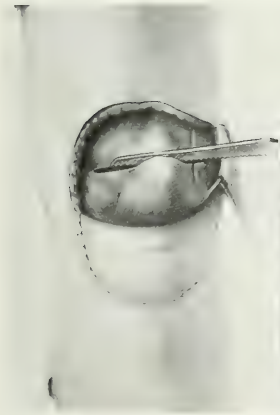

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 1. Line of incision.
Fig. 2. Dissecting out ulnar nerve.
Fig. 3. Cutting through the muscle and fascia down to the joint.
Fig. 4. Sawing through olecranon and end of humerus.
Fig. 5. Splitting off tip of olecranon with chisel.
Fig. 6. Cutting out with rongeur forceps bit of olecranon tip left in humerus.

through an arc of 3 inches and the elbow forcibly flexed to an acute angle and extended to 160 degrees. Pronation and supination were approaching normal.

Hoffa (31), in 1906, reported a series of arthroplasties, seven of which were on the elbow. In one, a magnesium plate was used. This operation was unsuccessful owing to the formation of gas in the joint causing a fistula which closed only after the rest of the plate had been removed from the joint. The other operations in which fat, fat and fascia, or fascial flaps were used, were all successful. In 2 of these

Fig. 7

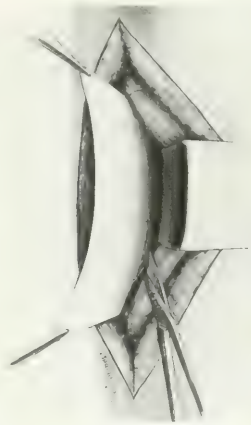

Fig. 8

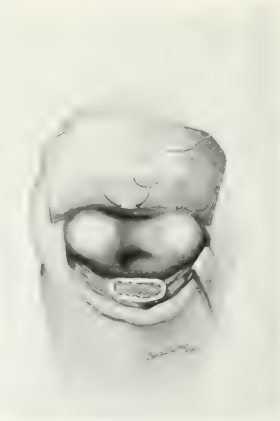

Fig. 9

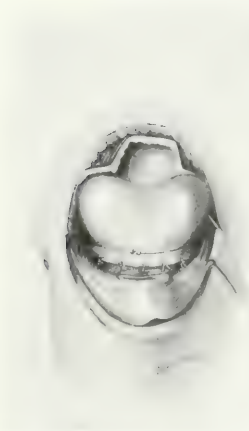

Fig. 10

Fig. 11.

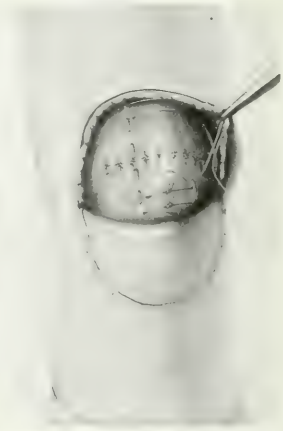

Fig. 12.

Fig. 7. Scooping out ulna and radius with curette.
Fig. 8. Cutting fascia lata from thigh.
Fig. 9. Sewing the flap of fascia lata to the elbow-joint anteriorly.

Fig. 10. Fascia sewed over humerus, tied with chromic catgut suture.
Fig. 11. Kangaroo suture throug hulna and olecranon tip.
Fig. 12. Stay sutures.

cases, the ankylosis followed scarlatina; in the others, gonorrhœal infection.

In 1905, Quénu (30,c) reported a third case in which there was great atrophy of the muscles. He used for a flap the inner part of the triceps sutured to the anterior ligament. Passive movements were begun in 10 days and later electrical treatment used but, as active motion was incomplete at the end of 2 months, he made a second intervention to recover a part of the tendon of the triceps, a large portion of

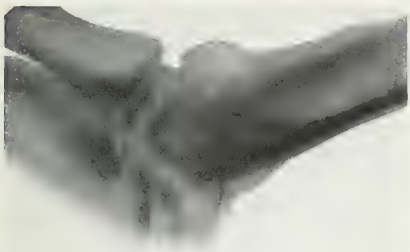

Fig. 13. Case 2. M. R. Roentgenogram showing ankylosis before arthroplasty.

which had been sacrificed. He cut the portion interposed close to the bone. He could then ascertain that there was no adherence between the superior surface of the interposed segment and the inferior cut surface of the humerus. The same condition obtained on the inferior surface. The tendinous segment had left a distinct cavity. The tendon of the triceps was sectioned and re-inserted on a little fibrous flap previously dissected on the forearm. The patient gained not quite complete extension and flexion to a right angle.

Dupuy (20), in 1905, reported 5 arthroplasties. Three of these were done by Jeannel, one by Kirmisson, and one by Launay. Jeannel used flaps of the brachialis anticus; Kirmisson, of the biceps; and Launay, a flap from the anterior ligament and the brachialis anticus. In all, good results were obtained. In two of Jeannel's cases, normal movements were obtained; in the other, the degree of motion was less but satisfactory function was gained. In Kirmisson's case, all the movements were present and the function good 5 months after the operation. Launay obtained passive motion from 80 to 155 degrees with free pronation and supination 5 months after the operation.

Huguier (35,a), in 1905, reported 2 cases operated on by Nélaton, with the interposition of a muscle flap. In one case, he gained good motion. In the second, re-ankylosis occurred. Huguier reported a third case by Ombredanne, by the same method.

Scudder (63) reported in 1906, 1907, and 1908, several cases in which he used Murphy's method successfully.

Pereira (50), in 1906, in an unreduced subluxation resected the ends of the bones and interposed a flap of triceps muscle with almost perfect functional result.

Bazy (6), in 1907, mobilized an elbow using a flap from the brachialis anticus. Nine months later, the function of the arm was almost perfect.

The same year, Stein (64) reported 3 cases from Bier's clinic in which triceps flaps were used. All were successful.

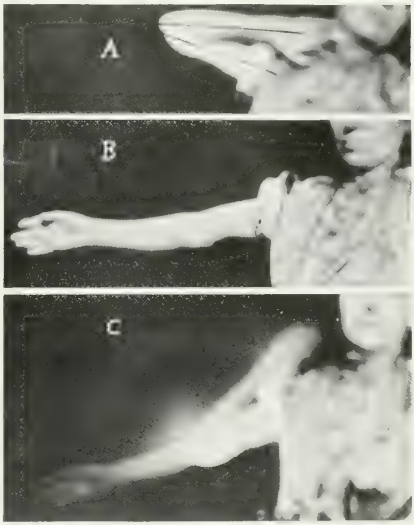


Fig. 14. Case 2. M. R. End-result. *a*. Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

In 1909, Huguier (35,b) reported an ankylosis which he mobilized, using a flap of brachialis anticus. Sixteen months later, the patient could touch his shoulder with his hand and extend his forearm to 150 degrees.

Cifuentes (11) reported in the same year a similar arthroplasty in which he obtained a month after the operation a good functional result with normal movements.

In 1910, Reiner (58) reported a series of twenty-eight arthroplasties, twenty-five of which were given in full with the after-results. Two others, recent cases, were reported with good immediate results. In three others, the histories were unknown. Of the others, nineteen gave useful arms, although one was a flail joint which lacked power but could be controlled by the muscles. The poor results were due in one case, a fracture luxation, to extreme atrophy of the muscles, and in a tubercular case, to extensive resection of the diseased tissue necessary, resulting in a useless flail joint. Re-ankylosis occurred in two cases. In one, it was due to operation too soon after trauma, a fracture luxation, and lack of after-treatment. In the other case, the author attributes the result to the disease, myostitis ossificans.

Thom (68) reported in 1910 a case of ankylosed elbow operated on by Ritter. He used freely transplanted fascia lata as an insert after the parts had been made freely movable. On discharge, there was

Fig. 15. Case 3. R. T. Roentgenogram showing position of ankylosis before arthroplasty.

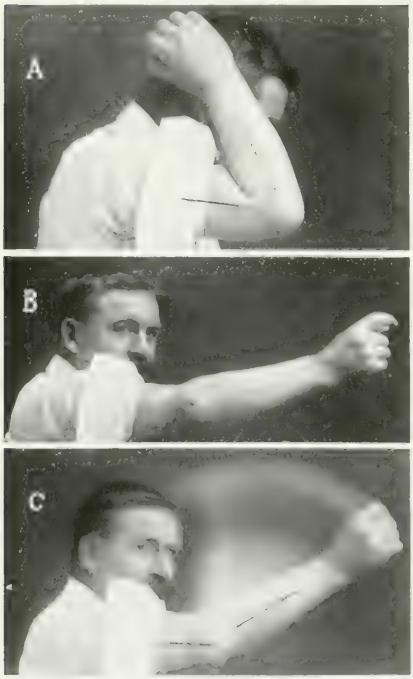


Fig. 17. Case 14. W. D. End-result. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

Fig. 16. Case 3. R. T. End-result. At left, voluntary flexion; at right, voluntary extension.

65 degrees flexion and 100 degrees extension. Pronation and supination which were very slight before the operation were unchanged.

Wille (76), in 1911, interposed supinator longus fascia with good result, gaining 95 degrees motion.

Whitman (75) reported two cases of arthroplasty of the elbow in which he used Murphy's method.

In 1912, Edmunds (21) reported an elbow ankylosis following fracture in which this method was likewise used. At the time of the report, active motion was not possible on account of the great atrophy of the muscles.

Denk (19) reported two of von Eisenberg's cases in which elbow-joints were mobilized with free fascia transplants with good functional results.

Neff (44) reported a case in which he interposed a pedunculated triceps aponeurosis flap between the humerus and ulna and the radius and ulna. Seven months after the operation, there was active painless motion of 180 degrees to 30 degrees and only slight lateral mobility. The joints of the wrist and hand, which were previously partially ankylosed, regained from a third to a half their normal range of mobility with the return of function to the elbow.

Delbert (18), in 1912, reported having done nine resections of the elbow with articular grafts. Most of these were too recent to determine the results, but he reported in detail two cases which were of a year's duration and appeared permanent. In one of these he used cartilage from an ankle-joint, in the other cartilage from an elbow. Both gave good functional results.

Charput (10,a) reported three cases in which he resected a flap of fat the size of the palm from the thigh and encapsulated the lower end of the humerus with it, suturing it to the neighboring muscles by anteroposterior and lateral sutures.

Conrad (12), in 1912, published a dissertation on the use of muscle flaps as interposing material. We have been unable to obtain a copy of this thesis.

Pomponi (53) advocates the use of a pedunculated fascial flap by the method of Durante. He cites one case in which he gained complete pronation and supination, nearly normal extension and flexion to 60 degrees.

Murphy (43,b) reported among a series of arthroplasties done by him twelve on the elbow by his pedunculated fat fascia flaps.

Mauclaire (39) mobilized an elbow, using cartilage from the astragalus to cover the defects. One fragment was put on the lower end of the humerus,

another between the radius and ulna. A roentgenogram later showed these grafts fused to the bone.

Osgood (47) reported sixteen attempts at mobilization by various methods in the different joints. He advises against arthroplasty in the hands of untrained operators.

Putti (55), in 1913, reported his arthroplasties to date. These included twelve elbow cases in which he used Kocher's incision and a free flap of fascia lata. He obtained stabile joints with a useful degree of motion. His histological research is referred to elsewhere.

Roepke (59) reported ten cases of ankylosis of the elbow in which he did arthroplasties using free fat flaps to interpose between the joints. He advised against beginning passive motion too soon. One of these cases was one of arthritis deformans shown in 1911 before the Medical Society of Jena. In others, the ankylosis had resulted from trauma, neisserian infection, and tuberculosis.

Exner (22) reported a case fourteen months after an arthroplasty in which a free flap of fascia lata was interposed. The arm was somewhat unstable but gave good function. The patient could lift heavy weights. At the same time Pupovac reported a second case by the same method.

Darling (13) reported an arthroplasty with the use of a pedunculated flap done in the presence of active infection. The immediate result was good.

Harris (27) discusses the contra-indications to arthroplasty. He reports two elbow cases by the Murphy method. In one he gained 75 degrees motion. In the other, there was 60 degrees motion.

Turner (71) reported an arthroplasty of the elbow for an ankylosis following a severe osteomyelitis. There had been a musculospiral paralysis from which the patient made a perfect recovery. The elbow had entirely healed but, at the time of operation, a small area of latent infection was found. Turner used a posterior skin incision and inserted a flap of fascia lata. The elbow was put up in extension. The next day, there was a recurrence of the paralysis with signs of local infection. Later, fearing re-ankylosis, he manipulated the elbow under ether into extreme flexion. Six months later, the boy had motion from 50 to 120 degrees and a useful arm, though the muscles were still atrophied.

Fig. 18. Case 5. E. M. Above, Anteroposterior roentgenogram after arthroplasty; below, lateral roentgenogram after arthroplasty.

The same year Murphy (43,c) reported an arthroplasty by his usual method. The patient left the hospital in 5 weeks with free motion within an arc of about 45 degrees.

Vulpius (73) believes that the elbow and hip offer the best chances for arthroplasty. He prefers

*a* *b* *c*

Fig. 19. Case 5. E. M. End-result. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion (not full range)

Fig. 20. Case 7. E. S. Roentgenogram showing position of ankylosis before arthroplasty.

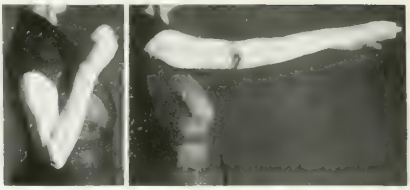

Fig. 21. Case 7. E. S. End-result. At left, voluntary flexion; at right, voluntary extension.

pedunculated flaps but also uses free flaps of fat or fascia and fat or Baer's membrane.

In 1914, Payr's (49) oldest case was about 4 years. He emphasizes the importance of removing the capsule or at least the synovialis as well as the fibrous cartilage. Payr has never met with a secondary dislocation nor a loose joint except in some of his first knee cases. The initial gain in motion was preserved or even increased with use. He had trouble with persistent swelling, more especially in cases where this had existed before operation for a considerable length of time or had been marked. He believes convalescence is shortened by waiting until the swelling has subsided. If re-operation is needed, he advises waiting at least 6 months. He reports twenty-two arthroplasties, of which three were elbows, one with a good result and two with very good results. He believes that if the indications are correct and the technique and after-treatment good, a favorable result is to be expected in 70 to 80 per cent.

Pupovac (54) reported a case of a girl of 19 whose elbow had become ankylosed at 130 degrees as the result of a severe arthritis. He did an arthroplasty using a posterior incision and a free fascial flap, gaining motion from 105 to 140 degrees. Five months later, he re-opened the joint and removed some exuberant bone that united the humerus with the ulna, gaining 70 to 130 degrees motion.

Owen (48) believes that the hip and shoulder offer the best fields for arthroplasty. The poorest prognosis is in the elbow and knee but if the former is ankylosed in extension, operation is advisable, as it will at least get the elbow into better position.

Davis (14) thinks that we should be conservative about opening a joint ankylosed by tuberculosis. He finds the elbow one of the most satisfactory joints for an arthroplasty as well as an excision but the results with the former are more brilliant. An excision requires the removal of one to one and one-half inches of bone to insure movement but, with an arthroplasty, only sufficient bone need be removed to interpose the flap and it is almost certain to give a stabile joint. He uses two pedunculated flaps, one from either side. The joint, he believes, should have drainage.

McCurdy (40) advocates the pedunculated flap in preference to the free flap, as he believes that the nutrition is better and that fascia will slough and require removal. He gives no experimental nor clinical evidence to bear out this statement. He prefers the Baer membrane, as it is more easily adjusted and there is, therefore, less blood clot; therefore less adhesions and better end-results.

Murphy (43,d) reported in 1915 a case of ankylosis following fracture. The elbow was ankylosed at about 150 degrees with a few degrees of motion. Seven weeks after operation, there was good pronation and supination and perfect freedom of motion.

Ashhurst (4) uses an incision along the external supracondylar line and the external condyle detached from the humerus with an osteotome. A pedunculated flap is inserted and the external condyle replaced by means of a Lambotte self-boring screw. He reports five cases. In these cases, there were three good end-results. One case had a flail joint with very slight power of extension. The fifth case had a limited motion but the patient refused forcible manipulation.

Gilbert (24) cites a case of dislocation of the elbow which existed 3 months. Good use of the joint was obtained after a Murphy arthroplasty.

Tubby (70) gives a careful consideration of the indications for arthroplasty. He believes that the best time for the operation is in early adult life, between 18 and 30 years. The mental state of the patient must be considered, as co-operation is essential; the occupation of the patient must be considered; the causative factor must be considered. The condition of the soft parts is important. A thin, scanty, and scarred skin will not be sufficiently nourished to stand the trauma. From the X-ray examination, an approximate opinion as to the condition of the joint is gained. He prefers a muscle flap for interposition but has also used fat and fascia and Baer's membrane. He does not begin passive motion for four weeks but thinks that active motion should be begun earlier. He reports one elbow case in which he used a muscle flap. At the time of the arthroplasty, insufficient bone was removed and re-ankylosis took place. Eight months later, he did a secondary operation to remove the mass of new bone. Following this, all movements were free but the elbow was slightly flail.

Fig. 22. Case 8. W. D. Position of ankylosis before arthroplasty.

Fig. 23. Case 8. W. D. Roentgenogram showing ankylosis before arthroplasty.

Charput (10,b) reported a case of arthroplasty for ankylosis following luxation of the elbow. He used two lateral pedunculated flaps and sewed the skin up tight. The arm was put up in a sterile dressing in extension. The following day, the arm was flexed. Mobility returned in 2 days. In 42 days, extension and flexion were complete and vigorous. He attributes the good result to sewing up the wound without drainage and the immediate mobilization.

Graff (25) describes a case in which he interposed a flap of triceps muscle with almost complete return of normal motion.

A brief report of an arthroplasty with a pedunculated flap is given in Kennedy's case (36). The end-result is not reported.

Murphy (43,d) reported a case showing perfect motion seven months after arthroplasty for ankylosis from a fracture. A second ankylosis from tuberculosis showed a good end-result.

Whitman (75) exhibited before the New York Surgical Society a case in which an arthroplasty had been done for a fibrous ankylosis following tuberculosis. Four years before, an arthroplasty had been done using a pedunculated flap. At the second operation, the fibrous ankylosis was found to have become bony. Whitman used a flap of fascia lata at this operation. Whitman believes that in an ankylosis following tuberculosis, a free fascial transplant is essential to success, as the tissues about the joint are atrophied. His case showed a perfect end-result with normal flexion and 165 degrees extension.

Brown (8) gained 80 to 150 degrees motion in an arthroplasty by the Murphy method. The arm had been ankylosed in extension following acute metastatic arthritis.

Rovsing (60) reported before the Northern Surgical Society 2 successful cases in which the Murphy method was used. The ankylosis was the result of fracture. In the discussion Bergman and Haglund expressed the opinion that mobilization of the knee should not be attempted.

Moszkowicz (42) in his report in 1916 on his operations on war injuries to joints, gives among other cases 6 elbow arthroplasties. In all of these, a useful degree of motion was gained.

Plummer (52) reported two arthroplasties in which he used pedunculated fat and fascia flaps. One of his cases became infected and subsequently a portion of the end of the humerus had to be removed. The resulting joint was somewhat flail but gave good function. His second case also had good motion but his facility for moving the joint was not very good.

McKenna (41) advocates a modification of the Murphy method. He uses a very long flap extending well out over the external condyle and an external flap for the head of the radius. He believes that success is more certain when the arthroplasty is done early, as the atrophic changes about the joint are less. For this reason, it is important to make a correct diagnosis of the infecting agent. The gonococcus lives a comparatively short time in the joint tissues and an arthroplasty may be done earlier in an ankylosis from this agent than in one from staphylococcus or streptococcus or a chronic infection as tuberculosis. In the discussion which followed, Gibbons reported an arthroplasty of the knee that had come to his notice in which hypermobility existed necessitating the permanent use of a brace.

Ryerson (61) gives in detail his operative technique in arthroplasty on the elbow-joint. He uses a long posterior incision avoiding the olecranon. The triceps tendon is cut and a thin shell of bone removed from the external condyle, taking the origin of the extensor with it. Then a shell from the internal condyle is removed. The joint is dislocated. After it is remodeled, a flap of fascia lata is used to interpose.

Thomson (69) reports the end-results in an elbow arthroplasty by the Murphy method. Ankylosis was the result of sepsis following a fracture. Seven months later, elbow motion was good but somewhat

*a* *b* *c*

Fig. 24. Case 8. W. D. End result. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

restricted. His successful cases have all been traumatic. He believes that neisserian infection is a contra-indication to arthroplasty, as it stimulates bone formation. Tuberculosis is also a contra-indication on account of the recrudescence of the disease.

Fig. 25. Above. Case 11. E. S. Roentgenogram showing ankylosis before arthroplasty.

Fig. 26. Case 11. E. S. Roentgenogram showing dislocation after arthroplasty.

Ceccarelli (9) used strips of fascia lata in an arthroplasty on a post-traumatic ankylosed elbow. The end-result was perfect flexion, extension to 165 degrees, and almost normal pronation and supination.

Olivieri (46) reports two arthroplasties with interposition of strips of brachialis anticus. The end-results were perfect.

In 1918, Baer (5) reports in full his arthroplasties to date, by the use of chromatized membrane. In one hundred cases, there were three arthroplasties on the elbow-joint. In one of these, re-ankylosis took place, one died, and the third showed 25 degrees motion. He believes that the elbow is the least favorable joint for arthroplasty and that the success from the interposition of muscle or fascial flaps is due to the amount of bone removed rather than to the flap itself and that these operations are in fact excisions. In the discussion of this paper, Galloway and Freiberg express the opinion that an arthroplasty has no advantage over an excision. Davis states that with an arthroplasty a more stabile joint is obtained.

Albee (2) uses a vertical incision directly over the olecranon. After retracting the ulnar nerve and dissecting the soft tissues, he saws through the olecranon from within outward. After remodeling the joint, he interposes a flap of fascia lata containing as much fatty tissue as possible. The arm is put up in plaster at right angles. After 10 days, passive motion is begun.

*a* *b*

Fig. 27. Case 11. E. S. End result. *a*, Voluntary flexion; *b*, voluntary extension; range of motion.

*a* *b* *c*

Fig. 28. Case 12. M. D. Motion 4 months after arthroplasty. *a*, Voluntary flexion; *b*, voluntary extension; *c*, range of motion.

Henderson (29), in 1918, tabulated the end-results of the 43 arthroplasties done at the Mayo clinic. Twenty-one of these were on the elbow. He found the prognosis most favorable in the jaw and next in the elbow. The knee was the most unfavorable position. In reports from other surgeons he found a general agreement as to prognosis.

Kerr (37) reported an arthroplasty of the elbow, giving in detail his method of operation. He interposed some peri-articular fascia. The result was a useful, movable joint with no atrophy of the muscles.

Hohmann (34) reported 5 elbow arthroplasties in 1918 in which he inserted part of the triceps with good immediate results. Lange at the same time showed 6 cases in which useful joints were obtained and the patients were enabled to resume their old occupations. He used fat or muscle flaps.

Murphy's (43,a) experiments on animals led him to conclude that fatty tissue was essential to the new joint foundation. This fatty tissue, he believed, under pressure formed connective tissue and the breaking down of fat globules together with this hyperplasia of connective tissue resulted in the formation of bursæ. Similar results were reported by his assistant, Neff.

Sumita (66), in 20 experiments on dogs, interposed muscle and tendon as well as fascia between the surfaces of resected joints and found no marked difference resulting from the tissue used.

Davis (15) found that the interposed fascia did not degenerate but preserved its normal histological characteristics. Putti (55) came to the same conclusions.

Hohmeier and Magnus (33) obtained the same end-results with and without the interposition of living tissue.

Allison and Brooks (3) studied the production of joints with free and pedunculated fascial transplants and also with chromacized membrane and fascia impregnated with silver nitrate. They found no difference in the end-result between pedunculated and free flaps. They found with Baer's membrane the reaction of the surrounding tissues was of such intensity that even at the time the membrane was disintegrating there were formed adhesions between the granulating surfaces. The silver impregnated fascia caused relatively little reaction in the surrounding tissues.

Steindler (65) found in experiments on a small series of dogs that no adhesions were formed after scraping the cartilage covering either with the insertion of fascia or in controls. Pedunculated muscle fascia flaps were transformed with a con-

Fig. 29. Case 15. L. P. End result after arthroplasty. At left, voluntary flexion; at right, voluntary extension.

Fig. 30. Case 17. I. H. End-result. At left, voluntary flexion; at right, voluntary extension.

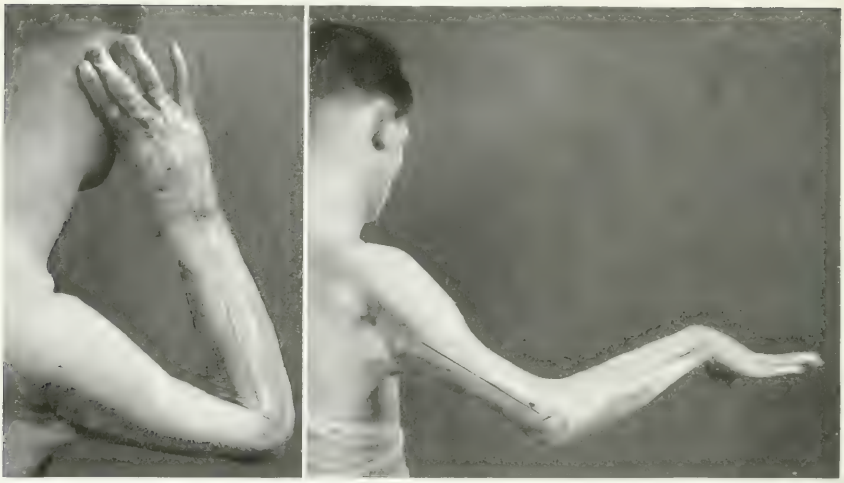

Fig. 31. Case 19. J. T. End-result. At left, voluntary flexion; at right, voluntary extension.

nective-tissue pannus adherent to the denuded areas of the bone. The denuded areas showed lacunar reformation of cartilage but no re-formation of bone.

Phemister and Miller (51) obtained similar results in the elbows and knees of dogs whether no interposing material was used or free or pedunculated flaps were used. The flaps largely break down and the resulting joints are alike in the three types of operation. They do not see how any appreciable amount of nutrition can be furnished by the circulation through the pedicle. They believe that the circulation in the surviving portions is through adhesions to the parts with which they come in contact.

### INDICATIONS AND CONTRA-INDICATIONS

No attempt at mobilization should be made until epiphyseal growth has ceased. If it is made before this, it is impossible to remove sufficient bone to secure good motion without grave danger of injury to the epiphyseal line. Ankylosis is almost sure to result.

Where the joint has been the seat of an infectious process, arthroplasty should not be done until all signs of an active process have ceased. As a rule, however, we should not wait too long, as convalescence is lengthened where atrophy of the soft parts from disuse is marked. The exception to this rule is in the case of a tubercular joint. Here, it is a matter of considerable question as to whether an arthroplasty should be done. If at all, it should be done only very late, a number of years after all acute symptoms have subsided. Even then we run a risk of lighting up a quiescent process.

### OPERATIVE TECHNIQUE

The arm from the wrist to the shoulder and the leg on the same side from the hip to the knee are given a two-day preparation. At the time of the operation, a tourniquet is applied to the upper third of the arm and an application of iodine made to the skin.

A semicircular incision is then made, beginning over the external condyle (Fig. 1) running down about 2 inches and up over the internal condyle. The wound is sponged with alcohol and carefully clamped off to avoid handling the skin during the operation. The flap containing skin and superficial fascia is then dissected back to the base line and retracted. The ulnar nerve is isolated and dissected out of its sheath (Fig. 2). It is sometimes difficult to find this nerve, but it is always to be sought at the inner side of the in-

ternal condyle. It should be dissected out carefully with a blunt dissector so as not to break nor injure it. After it has been freed for 1.5 inches, gauze is passed beneath the nerve and it is retracted to the ulnar side. It is then freed further with blunt dissection with gauze.

A transverse incision is then made extending down through the periosteum (Fig. 3). This incision follows in direction the superficial one and outlines a flap which is to be dissected back and preserved *in toto* for subsequent covering for the joint. The pulling back of this flap is a hard and tedious process until it is well started, after which it can be peeled back readily by blunt dissection. It is the inner side that is the hard part, as the layer is thin here and we must exercise great care not to buttonhole it. The olecranon is then sawed through. After this, it is frequently possible to break open the old joint. In some cases, however, ankylosis is bony and the joint cavity obliterated. Cases of this kind are the most difficult. It is in these cases necessary to saw through the joint. The tip of the olecranon has to be chiselled out and dissected back with its posterior flap. Usually the olecranon is too large and it is well to take off a little of it.

The capsule, fascia, and ligaments are then dissected back so as to allow the lower end of the humerus to protrude into the wound when its edges are snipped off with rongeur forceps and a new trochlear or intercondylar surface formed. A shoemaker's rasp is used in filing the extremity as near like the normal humeral end as possible. After this modelling, a piece is removed corresponding to the olecranon fossa in the normal humerus. One has to be careful about making this cup, as the success of the operation depends largely upon attention to such small details. This modelling is largely done with a saw and a file.

To insure good function, the joint surfaces should fit accurately before the fascia is applied, but the joint should not be too loose. Only sufficient bone must be removed to give free motion. If too much of the ends of the bones is removed, a flail joint will result, giving the operation no advantage over an excision. When this mortising is completed, the fascial flap is dissected from the leg (Fig. 8). An incision is made on the outer side of the thigh,

Fig. 32. Case 21. I. L. End-result. Above, voluntary flexion; below, voluntary extension.

a little below the middle, extending down to the fascia lata. After a flap of fascia 5 to 7 inches long by 4 to 5 inches wide is dissected out, the wound is closed.

This fascia, which is free from all fat, is placed about the newly fashioned humeral condyles and attached anteriorly to the capsule (Fig. 9) and posteriorly to the periosteum of the lower end of the shaft of the humerus with interrupted chromic catgut sutures No. 2. Chromic catgut No. 2 is then wound twice loosely around the shaft just below the interrupted suture line.

The forearm is placed in apposition to the condyles. Two drill holes are then made in the olecranon process and two others opposite

Fig. 33. Case 24. F. A. End-result. At left, voluntary flexion; at right, voluntary extension.

them in the shaft of the ulna. Through these, kangaroo tendon is passed and tied. The inner layer is now sutured with chromic catgut No. 2 and the skin and fascia with plain catgut No. 2. Dry sterile dressings are applied and the arm put up in plaster beyond a right angle.

### AFTER-TREATMENT

If there is no evidence of infection, the cast should remain on for a week. It is then split and the dressing changed. If there is a persistent temperature, a window should be cut in the cast and the wound inspected.

Passive motions are begun in about 10 days, if normal healing has taken place. The arm is always kept above a right angle. After 3 weeks, gentle massage is applied. Baking is begun in 6 weeks, three or four times a week.

The ultimate success in these cases depends very largely on the after-treatment. The patients should be under observation for a long period of time. Frequent X-rays should be taken so that we may follow the bony changes in the joint. If motion begins to shut down, the arm should be manipulated under an anæsthetic and the elbow put up in acute

Fig. 34. Case 25. F. D. End-result. Below, voluntary flexion; above, voluntary extension.

Fig. 35. Case 26. S. S. Roentgenogram showing ankylosis before arthroplasty.

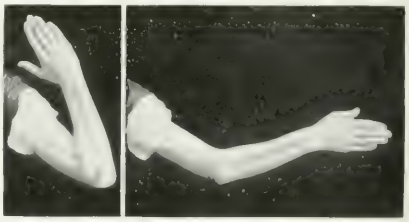

Fig. 36. Case 26. S. S. End result. At left, voluntary flexion; at right, voluntary extension.

flexion. Occasionally, motion becomes limited, due to an exuberant growth of new bone. In this case, a secondary operation should be done to remove this, but it should not be undertaken for at least 3 months after the original operation.

Case 1. F. P., December, 1909, fell on her elbow in March, 1908. The injury was treated as a sprain and the elbow put up in a splint. She recovered except for a slight stiffness and pain, but as time went on the motion became less. Later, she was under observation for 6 weeks in the out-patient department.

On November 18, 1908, an attempt was made to gain motion by removing as much exuberant bone as possible. Following the operation, the patient suffered from a Volkmann's paralysis. She made a splendid recovery from this paralysis but, unfortunately, on account of the sensitiveness of the elbow, there was not so much motion as before the operation. An arthroplasty was therefore advised. This I did in December, 1909, using the Murphy method.

The circulation of the skin above the original site of the flaps became somewhat diminished and there was a small amount of sloughing. The wound was dressed each day and on the fifth day daily attempts at motion were begun. In the course of a month, massage and baking were again taken up and continued until May, 1910.

The patient was last seen April 11, 1919. She had at this time motion from 45 to 125 degrees and no tenderness. Except for extension, the result was perfect. Previous to her marriage, she had used her arm daily in her employment as a stenographer.

Case 2. M. R. for 13 years had had attacks of rheumatism affecting the ankles, elbows, and knees. The physical examination was negative except for the joints. Both knees were slightly flexed and the right one was ankylosed showing scars on either side. The right ankle showed some contraction of the tendo achillis. The left elbow showed good motion except for 10 degrees limitation in extension; the right was ankylosed at 125 degrees.

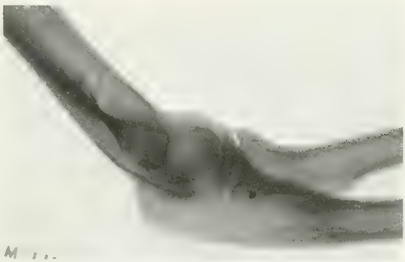

Fig. 37. Case 27. N. B. Roentgenogram showing position of ankylosis before arthroplasty.

The patient was admitted to the orthopedic service of the Carney Hospital, September 6, 1910, where very slight improvement took place in her knees and feet under conservative treatment. In October, on account of the swelling and bogginess of the left knee, an arthrotomy was advised. This was done October 19. Daily manipulations were begun on the fifth day, and an uneventful recovery took place as regards the knee.

As the elbow was stiff and in an ungainly position, operation on this joint was advised. On November 5, 1910, an arthroplasty by the Murphy method was done on this joint.

November 10, the right hand was considerably swollen and painful, for which pressure and hot fomentations were applied. The skin on the upper part of the arm became somewhat necrotic from poor circulation and later sloughed.

November 30, passive motion was begun and repeated daily. The first attempt was made at motion, when 30 degrees were attained. Following this, progress was continuous and a gradual gain in motion was made. Later, massage was ordered for the hand, forearm, and shoulder.

January 11, 1911, about 30 to 40 degrees of motion in flexion and extension were obtained. The wound showed heavy granulation tissue. A week later she

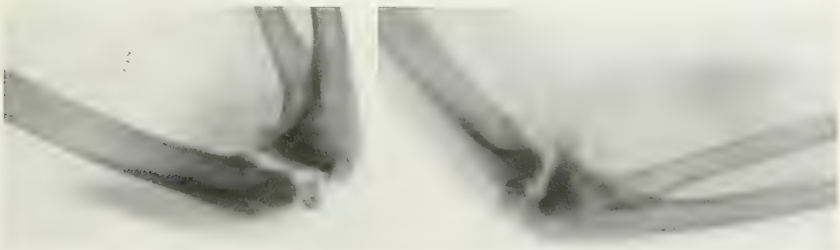

Fig. 38. Case 27. N. B. End-result. At left, voluntary flexion; at right, voluntary extension.

Fig. 39. Case 28. W. M. End-result. Below, voluntary flexion; above, voluntary extension.

was discharged from the hospital. Dressings were to be done at home.

February 28, she was readmitted to the hospital for manipulation when normal motion was obtained.

March 13, the patient was discharged to continue massage and manipulation at home. Since this time, she has been seen in the out-patient department. There is practically no lateral mobility and the end-result is perfect function.

Case 3. R. T. In this case, ankylosis had followed a fracture 5 years previously. A year and a half before, an attempt was made at the Massachusetts General Hospital to gain motion by open operation, followed by Zander treatment and baking. At the time when I first saw her, there was no pain in the arm but the stiffness was increasing. For this, an arthroplasty was advised.

On July 26, 1911, I did an arthroplasty by the Murphy method. The ether recovery was good but the patient showed a mild paralysis of the ulnar nerve which disappeared 2 days later.

The wound was dressed daily, when it showed considerable discharge of fat necrosis, but no infection was apparent. The arm was very sensitive and painful on movement. The motor power of the third and fourth fingers was restored but sensation was still slightly impaired. Following this, recovery was uneventful, and patient was discharged from the hospital on August 19 to report to my office.

October 24, the patient was readmitted to the Carney Hospital for manipulation, which was done the following day. She was discharged on October 26 with the arm in acute flexion.

February 18, 1914, the patient could extend the elbow to 165 degrees and flex to 25 degrees. The patient plays the piano and does all her housework.

Case 4. W.D. was referred to me by Dr. A. W. Shea of Nashua, New Hampshire, and was operated upon before the New Hampshire Surgical Club. On March 25, 1911, he received a contused wound of the left thumb, which became septic, requiring, 1 week later, his entrance to the hospital, as sepsis had become general. Five incisions were made in the left hand, two in the left wrist, one close to the left elbow-joint, and one in the left hip. All had drains put in. A student in the hospital opened a swelling near the right elbow and cut into the joint. At the end of 21 weeks the patient was discharged from the hospital with bony ankylosis of the right elbow with but a few degrees of motion in the left elbow. Both joints were slightly flexed. The left wrist had a sinus which still drained a little and he had little motion in the fingers, being unable to flex them to a right angle with the palm of the hand. He was unable to feed himself or to touch his head with either hand. He entered St. Joseph's Hospital a few weeks later and I did an arthroplasty on his right elbow, in March, 1912, using a flap of fascia lata to interpose. A hard bony ankylosis was found. The skin was closed with silkworm-gut and a voluminous dressing applied with the arm at a right angle. Arm and forearm were placed on pillows with heavy dressings but no splint. Passive motion was begun on the fifth day. Primary union took place in the wounds of the elbow and thigh. Passive motions were continued and increased, but at the end of 6 weeks it was found that the patient could not use either biceps or triceps muscles and he had lost all power from long disuse. However, after several weeks he educated the muscles by counting and attempting contraction at the same time and finally was able to flex the forearm himself, since which time improvement has continued.

He has now full motion in flexion, extension, and rotation and is able to feed himself and to do chores about the house and put on his own clothes. Previous to operation, he was entirely helpless, unable to care for himself in any way.

Case 5. E. M. Two years before, the patient became ill with infectious arthritis which at first affected the knees. The trouble started slowly with general poor health. There was no history of a neisserian infection but the patient was very much constipated and suffered more or less from tonsillitis. Later, the elbows became painful and could not be straightened out.

Physical examination showed a thickening of the capsule of the left elbow, with about 35 degrees limitation in motion. The left knee showed extension to within fifteen degrees of straight. The patient walked with a marked limp and flexed knees. General treatment was prescribed, with forcible extension of the knees. As motion in the arm had shut down leaving it ankylosed at 100 degrees, an arthroplasty on this joint was advised.

February 25, 1913, I did an arthroplasty, using my fascia lata method.

March 24, the arm showed no swelling. There was little pain and the patient's general condition was fair. There was about 15 degrees motion. Gentle manipulation was ordered.

December, 16, the wound had healed by first intention; supination was three-quarters normal, extension was to 170 degrees and flexion to 10 to 15 degrees beyond a right angle. The patient could reach the opposite shoulder with the thumb with ease but could not dress the lower part of the hair. The muscular power was as good as in the right arm. To gain more motion, a forcible manipulation was advised.

December 29, under ether, extension to within five degrees of straight was obtained and flexion to 45 degrees.

January 26, 1914, examination of the arm showed no lateral mobility and no crunching crepitation. Mobility was from 150 degrees to 70 degrees.

December 10, 1914, the patient showed voluntary motion from 55 degrees to 145 degrees.

Case 6. M. B. was admitted to the House of Mercy Hospital, Pittsfield, June 15, 1913, suffering from a bony ankylosis of the right elbow. Two days later, I did my usual arthroplasty putting up the arm in plaster in full extension. Recovery was uneventful. The arm was twice manipulated under ether, on July 29 and on August 13 to gain further flexion. She was discharged September 24, wearing her arm in a short sling. This was a clinic case and I have been unable to obtain any later data on the case.

Case 7. E. S. was admitted to the Carney Hospital, August 11, 1913, for immobility of the right elbow and right knee. Six years previously, the patient had had an acute illness accompanied by fever and pain and swelling in the joints, for which she was treated in her home, without relief. At the end of 8 months, the pain and swelling had disappeared from her left shoulder and elbow so that she was able to feed herself, but she remained in bed for 12 months and after this was in a wheel-chair for 2 years. The symptoms continued to subside on the left side until at the end of the third year, she was able to get about with a cane. As the fever continued to subside and the pain and swelling disappeared, fairly good motion returned to all the joints except the right elbow and the right knee, in which pain and stiffness continued at the end of the fourth year and no motion was possible. This condition continued up to the time of admission. August 14, roentgenoscopy revealed an ankylosis of the elbow-joint and of the patella to the femur.

August 20, I did an arthroplasty of the right elbow, using a flap of fascia lata. A light plaster cast was applied. Following the operation, the patient made a good ether recovery. There was slight pain in the elbow.

August 27, the cast was split for dressing.

September 1, the wound had healed by first intention except for a slight discharge on the upper border. September 4, daily manipulation of the elbow was ordered.

September 10, the arm could be extended completely and flexed to 15 degrees beyond a right angle.

September 15, traction was applied for flexing and extending the arm.

October 1, active motion was possible.

October 15, I manipulated the arm under ethyl chlorid.

She was discharged from the hospital. May 15, 1919, 5 years and 10 months after operation, she writes "the arm is doing excellent work." Photographs taken at this time show practically full extension and flexion.

Case 8. W. D. The previous history of this case is given under Case 4. After the arthroplasty on the right elbow, the patient requested that a similar operation be done on the other elbow. The roentgenogram showed a bony ankylosis at 90 degrees. On January 31, 1914, I did an arthroplasty on the left elbow-joint, using the same method applied in the case of the right elbow. The end-result was a stabile useful elbow, with motion from 60 to 160 degrees.

Case 9. R. B. was seen in consultation March, 1914, suffering from partial loss of function of the left elbow, as the result of an old fracture of the olecranon and external condyle and was unable to extend the elbow beyond a right angle, with supination limited one-fourth. An arthroplasty was advised.

This was done at the Carney Hospital on March 17, 1914. The usual technique was used and the arm put up in a sterile dressing in extension. The boy made a good ether recovery, slept well, and suffered no pain.

The wound remained clear until the 23d when it appeared reddened and showed some discharge. The following day, the axillary glands were tender to the touch and the hand showed some œdema. Hot poultices were applied.

By the 27th, the pain was relieved and the glands were not palpable. The wound was clean. Two silkworm-gut sutures were applied to prevent the spreading of the wound.

On March 31, a plaster cast was applied from axilla to finger tips in 15 degrees flexion and one-half supination.

On April 1, manipulations were begun and continued daily.

On April 11, the patient showed full pronation and supination but only about 45 degrees flexion.

On April 18, a splint was applied to increase flexion.

On April 23, I gained 45 degrees flexion, putting the elbow up in plaster in acute flexion. This cast was split on April 29. On May 1, the arm was put up in plaster at 10 degrees' flexion. A window was cut in the plaster and the wound dressed. The patient was then discharged to have the arm dressed by his family doctor. I have been unable to obtain later reports on this case.

Case 10. E. E. had fractured his elbow 8 years before. He entered the Massachusetts General Hospital 11 days later. The roentgenogram showed a supracondylar fracture, probably epiphyseal, with a

good deal of displacement of the lower fragment. A closed reduction was attempted under ether and the elbow put up in plaster with only a little flexion. Seven weeks later, he re-entered the hospital. At this time, the X-ray showed a very faulty position with some ankylosis of the joint. An osteotomy of the joint was done and the arm elevated. The arm was put up at an angle of about 150 degrees and the patient discharged to the convalescent home.

Three weeks later, he re-entered the hospital. At this time the elbow was swollen and very tender. The elbow was incised and the abscess drained and hot soaks ordered. He was discharged a month later,

Two months later, he re-entered the hospital for persistent sinuses in the arm, which were incised and drained. A week later, he was discharged relieved.

The patient entered the Carney Hospital November 28, 1913. At this time there was considerable atrophy of the arm and forearm. The elbow was ankylosed at 85 degrees and showed the scars of the previous operations. Ether manipulation was done on the wrist and later on the elbow.

Later, December 24, 1913, an excision of the semilunar, scaphoid, and pisiform was done.

On January 14, 1914, I did an arthroplasty on the elbow. At the time of the operation, the ulnar nerve was not found in its usual bed, probably having undergone degeneration. No bony landmark could be made out.

He made a good recovery from the operation. The wound remained clean but showed a slight serous exudate. Later, the wound showed a slight slough.

The elbow was manipulated on February 20, gaining motion to a right angle.

Five weeks later he was discharged to be treated by his family physician.

This case was not seen again until recently, when he showed a fibrous re-ankylosis with marked muscular atrophy.

Case 11. E. S. sustained a fracture of the right elbow on October 4, 1913, as the result of a fall of 42 feet. The roentgenogram showed a transverse fracture of both condyles with the radial head dislocated laterally and anteriorly.

Physical examination was negative except for the right arm. The shoulder appeared normal. The elbow was held at 150 degrees extension with less than 3 degrees motion. Supination was limited one-fourth. The wrist showed a Colles fracture unreduced. Flexion and extension were both one-half normal. Eversion was limited three-quarters and inversion four-fifths.

On March 25, 1914, I did an arthroplasty on the right elbow, using a flap of fascia from the thigh. When the joint cavity was opened, it was found that the synovial tissue was hypertrophied and there was much fibrous callus formation infiltrating the articular surfaces. A transverse fracture of both condyles was noted. The head of the radius was impacted and was surrounded by callus formation.

Five-eighths of an inch of the condyles was sawed off square at right angles to the shaft of the humerus. The joint surfaces were smoothed off and the operation completed according to my usual method. The arm was put up in plaster in an extended position. The patient made a good ether recovery but suffered considerably from pain, for which morphia was ordered, and the following day the arm was put up in suspension. He continued to suffer considerable pain for four days, after which the pain abated.

On March 29, the wound was dressed and was found clean with some serous discharge.

March 30, the cast was split and a voluminous dressing applied with splints to the forearm.

March 31, the patient was seen in consultation by Dr. Courtney, who reported a tourniquet paralysis and advised electricity and massage.

April 1, the wound was dressed and found clean and healing by second intention.

April 5, the patient was out of bed and walking about the ward. When dressed, the wound was found clean.

April 10, the wound was dressed. The motion in the elbow was good with good supination and about 45 degrees flexion. A nerve report was ordered.

April 15, the nerves were reported responding to the faradic current. The prognosis was considered good. Massage was advised.

April 18, the patient was discharged from the hospital to report daily at my office.

November 30, the patient re-entered the hospital for operative interference in an attempt to gain increased motion. Both bones of the forearm had dislocated backward and the head of the radius was very much enlarged. Motion was from 150 degrees to 50 degrees with the carrying angle markedly increased.

On December 2, after the usual preparation, a 4-inch incision was made over the external condyle. The removal of the enlarged head of the radius caused a marked increase in motion but the posterior dislocation was not improved. The internal condyle was chiseled loose and removed through a small incision over the fragment. After the end of the humerus was smoothed as much as possible with a rasp, the wound was closed and a cast applied with the arm at right angles. A good ether recovery followed.

After the operation, the patient suffered considerably and showed some swelling of the arm. On the fourth day, the cast was split, when the patient experienced relief.

On the 7th, the patient was comfortable and out of bed. The following day he was discharged to report to my office. The end-result shows nearly normal range of motion with a stabile, useful joint.

On October 29, 1920, he writes: "I can crank a Ford. I can do anything that I ever could. My work is driving and repairing automobiles and I have had to change a 38-7 tire on the road, which requires the use of two good arms."

Case 12. M. S. had suffered from a chronic arthritis, probably a neisserian infection, affecting both wrists, the left knee, and the right elbow. The

trouble had begun 4 years before and was gradually getting worse until she was unable to work. The left knee showed thickening and slight heat. It was held in 45 degrees permanent flexion and showed only 10 degrees motion. Her left wrist was ankylosed. The right elbow was ankylosed at right angles and was painful at one-half supination.

The patient entered the House of Mercy Hospital on June 18, 1914, where an arthrotomy followed by oil injections was done on the knee and an arthroplasty on the elbow. Four months after arthroplasty, the patient showed a range of motion from 60 to 140 degrees and a stabile, useful joint.

Case 13. M. F. had a severe polyarthritis when 6 years old. At this time, she was under treatment at the Holyoke City Hospital for 10 weeks, receiving general treatment from which she experienced temporary relief. Since then, she has suffered recurrent attacks of acute arthritis.

When she entered the Carney Hospital on April 23, 1914, physical examination showed an involvement of her elbows, wrists, fingers, knees, and ankles in the infectious process. Motion was limited and the joints were swollen and contained a small amount of fluid. The elbows were ankylosed at 125 degrees. Consultation was held with the medical, surgical, and laryngological staffs, whose reports were negative, except in regard to the tonsils. Following their removal on May 16, she showed marked improvement in the hands and feet under conservative orthopedic treatment.

On June 10, her wrists, ankles, and knees were manipulated under ether. From this operation, she made an uneventful recovery.

As her elbows were ankylosed, an arthroplasty was advised on the right elbow. This I did on July 1 by my usual method. She made an uneventful recovery and on July 26 showed motion from 50 degrees to almost normal extension. Flexion later increased to within 15 degrees of normal.

On August 12, I manipulated the arm and put it up well beyond a right angle. On August 19, the elbow could be manipulated without force to beyond a right angle, with force to within 5 degrees of full. Following this, however, motion gradually shut down and the end-result was re-ankylosis. I believe that this result is to be expected in children, on account of the impossibility of removing sufficient bone without injury to the epiphyses.

Case 14. A. M. had suffered from infectious arthritis for 10 years. Her fingers, knees, and elbows had become stiff.

Physical examination was negative, except for the joints. The right elbow was ankylosed at 90 degrees with about 30 degrees motion. The wrists were ankylosed in slight flexion. Previous to the arthroplasty, her feet and knees were manipulated.

On November 14, I did an arthroplasty, inserting a flap of fascia lata. Convalescence was uneventful.

On February 10, I manipulated the elbow under ether, holding the elbow in acute flexion with bands of adhesive. She was discharged from the hospital on April 2 with motion from 45 to 100 degrees.

Case 15. L. P. I saw the patient for the first time July 10, 1914. The trouble had begun November 23, 1912, when she was confined in bed with a temperature of 102° and swelling of the wrists and ankles. It had progressed ever since in spite of orthopedic and other treatment.

Physical examination showed marked involvement of all the joints of the arms and legs with ankylosis and more or less pain and swelling. The left wrist was ankylosed at 35 degrees radial adduction and the left shoulder showed a bursitis. The left elbow showed a few degrees motion and was held rigidly at about 135 degrees extension.

The patient was advised to have the shoulder manipulated and put up in plaster and to have the deformity of the wrist corrected. For the elbow, an arthroplasty was advised.

On July 10, I did an ether manipulation of the hips, knees, and feet.

January 13, 1915, an arthroplasty was performed on the left elbow. The olecranon was found ankylosed to the humerus. Both humerus and ulna showed a large amount of bone atrophy.

On October 13, I operated on the wrist for ankylosis. I excised the heads of the first phalangeal joints of the four fingers besides the distal metacarpal head of the thumb and fourth finger.

On February 6, 1916, I did an excision of the shoulder.

The latest report on this case is July 23, 1919, at which time flexion was perfect; when standing or sitting, complete extension is possible. The action of the elbow, however, below a right angle is weak, due to muscular atrophy.

Case 16. G. F. The trouble began 8 years before with an infectious arthritis affecting the fingers of the right hand. Later, she had other attacks involving the other hand, the feet, ankles, and knees. About a year before she entered the hospital, she was confined to her bed for 8 weeks with an attack involving the elbows, hands, and ankles. Subsequent to this, the mobility in her hands and elbows had diminished. She entered the Carney Hospital on December 27, 1913, for relief of this condition.

Physical examination at this time showed marked involvement in the arthritic process of the elbows, fingers, ankles, and toes. The right elbow was ankylosed at 155 degrees. The left elbow showed motion from 160 degrees extension to 45 degrees flexion.

The patient received general treatment and was referred to the surgical department for an ileosigmoidostomy. She left the hospital relieved following this operation.

In January, 1915, she re-entered the hospital for relief of the stiffness of her joints. Since the ileosigmoidostomy, her general health has improved. Her joint condition, however, has remained unchanged.

Physical examination showed the right elbow permanently ankylosed, the left ankylosed at 90 degrees with 5 degrees motion.

On January 20, 1915, I did my usual arthroplasty on the right elbow. She made a normal recovery and left the hospital with a good amount of motion.

After she left the hospital, she had another acute attack of arthritis which affected this joint. Gradually, motion became more painful and shut down. For this condition, she re-entered the Carney Hospital. The X-ray showed anteriorly the development of new bone. A secondary operation was done at which the head of the radius was removed as well as the exuberant bony tissue.

Case 17. I. H. had fallen on her elbow 4 months before she entered the hospital. She had suffered considerably from pain and was unable to use her arm. At this time, I manipulated her elbow under ether and later manipulated it every 2 weeks in the Carney out-patient. On account of the limitation in motion, an arthroplasty was advised.

She entered the Carney Hospital on June 22, 1915. At this time, the elbow was slightly tender and motion was limited to forty degrees. There was no pain but the joint was somewhat enlarged and the bones felt rough. The roentgenogram showed an old fracture of the lower end of the humerus.

On June 23, I did an arthroplasty of the elbow-joint, using a free flap of fascia lata, after which the patient made a good ether recovery. The following day, the plaster was trimmed about the fingers. The fever and swelling of the hand continued for several days until, on the 28th, the cast was bivalved, when the temperature dropped and the œdema disappeared.

On July 3, the patient was up in a chair. On the 6th, the dressing showed a slight superficial sepsis. The motion of the arm was very much increased. She was discharged from the hospital on July 15, to report to the out-patient department. Following this, there was a gradual return of motion.

In June, 1919, 3 years after the operation, she showed a range of motion from 37 to 125 degrees.

Case 18. D. S. While playing basket ball, the patient had been pushed against the wall, injuring the right elbow. He suffered a good deal of acute pain immediately following this and soreness had persisted for several weeks. The elbow had gradually become stiff. Twelve months before this, D. S. had had an acute condition in the elbow, when it was hot and painful, but quieted down quickly.

Physical examination showed the right arm held in about 105 degrees flexion. About one-fourth pronation was allowed and supination was limited one-half. The patient's grip was good and he had apparently full use of the fingers and hand. There was very slight capsular thickening and the fossæ on either side of the olecranon were not as sharp as normal. The musculature of the arm was good. Sudden jerks in flexion and extension were painful.

Arthroplasty was advised. This was done by my usual method at the House of Mercy Hospital, Pittsfield, September 23, 1915.

The patient was last seen 2 years after the operation. He has been working with the General Electric Company and has been admitted to the National Guard. He states that in damp weather he has a little aching pain and cannot do heavy lifting. He can dress himself. In October, 1917, while playing a game, his arm was strained and something snapped, but he was able to keep on playing. The fingers got a little stiff afterward with pain up the arm. The weakness and inability to use the arm lasted 4 weeks but was followed by perfect recovery.

The arm at this time showed extension to 125 degrees and flexion to 20 degrees, pronation one-half. Musculature was good. He shows a perfect functional result.

Case 19. J. T. One year before the arthroplasty, his right arm had been severely burned while he was at work in a paper mill. The burn had become septic, resulting in marked contraction of the scar tissue for which an extensive skin graft had been done with very good result. His elbow, however, had remained stiff.

Physical examination was negative except for the right arm. The scar tissue extended from the fingers to the axilla on both anterior and posterior surfaces. The thumb was abducted one-half and the fingers held in hyperextension. They could, however, be flexed.

On October 4, 1915, I operated upon the elbow doing an arthroplasty with a flap of free fascia. At operation, the ankylosis was found to be fibrous.

The patient made a good recovery from the ether. The wound was dressed on the second day when it was found clean, but the skin suggested a slough in the middle of the incision. He was discharged from the hospital on the 22d after an uneventful recovery.

Two months later, the elbow showed a range of motion from 45 to 140 degrees and was free from pain.

Case 20. J. C. The right elbow had become stiff following an acute infection of the entire arm. Later, there had been a discharging sinus near the elbow-joint.

Physical examination was negative except for the right arm which showed some atrophy. All motions of the shoulder were normal. The elbow was solidly ankylosed at 165 degrees. Motion of the hand was limited. The X-rays showed a bony ankylosis of the elbow-joint.

On February 27, 1917, I did an arthroplasty by my usual method. This case was unusual in that the remodeling was very difficult. Ordinarily, after the olecranon has been sawed through, you can break open the joint or, at least, there is soft bone that is readily sawed through. But in this case, the joint was solidly ankylosed and every vestige of the joint had disappeared.

Following the operation, the wound showed some bloody oozing. On March 5, a window was cut in the cast and the wound was found healed and clean. The patient was out of bed on the 10th and 7 days later was discharged from the hospital. Baking and

massage were continued. The end-result was a stable elbow with good function.

Case 21. I. L. Her left elbow had become ankylosed as the result of an arthritis of 10 months' duration. When I first saw her, October 3, 1916, her elbow was very sensitive and painful. About 10 degrees motion was allowed in the joint which was held in 130 degrees extension. Supination was about one-third normal.

In spite of conservative treatment, the elbow continued to stiffen. As a roentgenogram taken February 17, 1917, showed a bony ankylosis, an arthroplasty was advised. This was done March 6, 1917, and was followed by an uneventful recovery.

Miss L. was last seen May 26, 1919. She stated that only occasionally did she have slight pain. Motion in the elbow was from 45 to 145 degrees and she had a stable, useful arm with no lateral mobility. Rotation was limited to 15 degrees in the mid-position. This loss of motion is apparently due to the enlargement of the head of the radius and its excision was advised.

Case 22. C. M. had a complete bony ankylosis of the left elbow in 145 degrees extension. The condition had existed for 17 years, since the patient was 14 months old, when she had broken her arm. The X-ray showed a complete obliteration of the joint.

On August 23, 1917, I did an arthroplasty at St. Luke's Hospital, New Bedford. After an uneventful recovery, the patient was discharged a week later to report weekly to the out-patient department.

On September 6, the cast was split and the wound dressed. The patient had 15 degrees motion. Her arm was put up in a sling and she was asked to manipulate the arm and report again in 2 weeks.

September 27, she returned and was advised to continue treatment.

On October 11, the patient did not show much gain in motion. She admitted that she was not carrying out instructions regarding exercising the arm. She was advised to have an ether manipulation.

October 25, she reported at the hospital but again was found not to be carrying out instructions.

November 1, she showed a slight improvement. She was advised to increase her exercises.

November 8, she was referred to the hospital for an ether manipulation.

December 20, she was again advised to have the elbow forcibly manipulated.

January 3, 1918, an ether manipulation was done and the arm strapped up in 30 degrees flexion.

On January 10, the patient reported and was found to be doing well. She was asked to report each week.

When the patient reported again a week later, she was found to be again not following directions. A further manipulation was advised.

On January 31, she visited the clinic for the last time. Manipulation was again advised. Since this time, she has been seen several times by our social worker and urged to return for further treatment, but this she has steadily refused to do. She is working daily in a mill. When last seen, May 19, 1919, she stated that she felt the arm would have been all right if she had come again for operation, but was afraid of the pain and her mother did not want her to go again to the hospital. This case shows the necessity of the co-operation of the patient in the after-treatment.

Case 23. M. R. fell on January 12, 1918, fracturing her elbow. Splints were applied at this time and remained on for 3 weeks. On March 7, an operative attempt was made at the Brockton Hospital to gain motion. I first saw Miss R. on June 4, 1918. At this time, her elbow was swollen and painful and allowed motion only from 155 to 160 degrees. It was held in permanent pronation with no motion in the radio-ulnar joint. There was a slight discharge.

A few weeks later she entered the Carney Hospital and on June 27 I manipulated the arm and applied a cast which was kept on 4 days. She was then discharged with her arm in a sling.

As the arm again stiffened, she re-entered the hospital February 10, 1919. At this time, her elbow was ankylosed at 90 degrees. On February 12, I did my usual arthroplasty. The soft tissue surrounding the joint presented a mass of scar tissue from which the ulnar nerve could not be isolated. The tissue through which the nerve must have run was therefore dissected back and retracted *en bloc*. The line of the old joint was discovered with difficulty.

The patient made a good ether recovery and was fairly comfortable the following day after some pain on the previous night. The cast was stained through by the discharge from the wound.

On February 14, a window was cut in the cast over the area of operation and a sterile alcohol dressing applied. The bloody discharge from the wound still continued on February 17. This condition remained unchanged until the 26th, when the wound showed some healing upon the outer side of the elbow. On the 28th, the discharge had decreased in amount but the dressing showed a slight amount of pus on the inner side.

On March 4, motion was possible from 80 to 105 degrees without pain.

On March 10, the arm was put up in a sling in as acute flexion as possible and daily manipulation of the fingers begun. The wound was still discharging.

On March 24, the discharge had decreased slightly in amount. The finger motions had increased.

On March 31, the condition was unchanged. Light massage was begun on the upper and lower arm. Dressings were continued twice a day.

On April 7, the arm was put up in a sling at about 70 degrees flexion. There was still a discharge. On April 14, there was some swelling back of the elbow-joint but no fluctuation was felt. The arm was kept quiet and the swelling subsided in a few days. The discharge gradually decreased, and on April 20 the patient was discharged to have the dressings done by her local doctor.

Case 24. F. A. suffered on May 30, 1916, from a severe osteomyelitis of the left humerus. The arm

was incised at this time and a sequestrum removed. Since then, his general condition had improved but he had suffered from wrist-drop since the operation, and motion in the elbow had been lost.

When A. was referred to me, the arm showed a seven and one-half inch scar on the outer aspect. There were two sinuses which discharged creamy pus. The shoulder motions were one-half normal. The elbow was slightly thickened and showed local heat. It was ankylosed at 110 degrees with a few degrees motion. There was complete wrist-drop. X-ray showed a diffuse osteomyelitis involving the whole humerus with some evidence of sequestrum formation in the upper third. A subperiosteal resection of the shaft of the humerus was done. From this operation, he made a good convalescence.

On August 15, 1917, the arm showed the scar healed. There was apparently a total regeneration of the humerus. The shoulder showed 45 degrees motion in abduction with good anteroposterior movements. The elbow was ankylosed at 100 degrees with a few degrees motion. Supination was limited. His wrist was fitted with a hyperextension splint.

On June 4, 1918, as the elbow had not discharged for a year, an arthroplasty was advised. This was done July 24 at the Carney Hospital. The elbow was found ankylosed at 160 degrees. There was a musculospiral paralysis.

Convalescence was uneventful. On August 10, the cast was removed. On August 10, motion without discomfort was possible from 70 to 120 degrees. He had a slight rise of temperature on the 13th but this quickly dropped. He was discharged from the hospital on August 17 to have dressings done by his family physician and to report from time to time to my office.

September 7, he showed 15 degrees motion. On September 17, there was less motion. On October 24, motion had shut down to 8 degrees and a manipulation was advised. This was done on November 10, 1918, following which the elbow showed 10 degrees motion.

On November 5, 1919, I did a tendon transplantation for the relief of the musculospiral paralysis with excellent result.

However, as motion in the elbow was restricted, further operative interference was advised. For this, the patient entered the Brooks Hospital where, on July 7, I removed the head of the radius and three-quarters of an inch of the humerus.

He made a good recovery. On July 28, he had motion from 45 to 90 degrees. On August 25, he had motion from 75 to 135 degrees. On October 26, he showed motion from 40 degrees to 160 degrees.

Case 25. F. D. In 1910, the right elbow became swollen and tender. At this time an open operation was done on the joint. Six months later, another operation was done, after which the elbow drained for 4 years and he lost the entire use of the arm.

Physical examination showed marked atrophy of the muscles of the arm. There were numerus scars above and about the elbow. The elbow was ankylosed at 180 degrees. Finger and shoulder motions were normal.

On August 10, 1918, by my usual method, I did an arthroplasty on his elbow. He made a good recovery and had a normal convalescence. Two weeks later, he was discharged to have daily dressings done by his family doctor. Motion at this time was from 80 to 100 degrees without pain.

He reported at my office on August 30. At this time, the wound was not quite healed. The elbow showed 30 degrees motion. Following this, he was seen about every 6 weeks. On October 18, the wound was found healed. Motion gradually increased.

On December 9, 1919, he showed motion from 35 to 145 degrees with full supination. The elbow was stable with no lateral motion. He has no pain, works as a telegraph operator and "lifts anything."

Case 26. S. S. was first admitted to the Burbank Hospital, Fitchburg, December 5, 1917, with a subacute neisserian infection. Five years previously the right knee had become swollen, and remained so for 3 months. A month later, the right elbow became swollen and painful. At that time, she could bend the elbow but, as this caused pain, she did not do so. At the time of her admission, she could not bend the elbow nor lift the arm, and the elbow region was swollen and painful. The Wassermann test was positive. She remained in the hospital 38 days, receiving general treatment and was discharged relieved.

She returned to the out-patient department, July 1, 1918. The arm was then put up in plaster from wrist to shoulder to remain on 2 months. She was told that her elbow would probably become stiff and would require an arthroplasty later.

On January 9, 1919, the patient was advised to have an arthroplasty done as her elbow had become stiff. Following the operation on February 6 she had an uneventful recovery. The cast was removed in 2 weeks, after which passive motion was begun. She was discharged March 18, 1919.

When last seen, April 3, 1919, she had a range of motion from 45 to 135 degrees.

Case 27. N. B. was admitted to the House of Mercy Hospital, Pittsfield, on March 4, 1919, for the relief of an ankylosis of 4 months' duration, the result of an infectious arthritis. There was marked atrophy of the left deltoid but no pain nor tenderness in the shoulder-joint and no limitation of motion. The left elbow was ankylosed at 150 degrees. She remained at this time in the hospital for a month under conservative treatment, then left the hospital unrelieved and was advised to return later for operative interference.

On June 24, she re-entered the hospital. At this time, the elbow was ankylosed at 150 degrees. I did my usual arthroplasty and obtained a very good immediate result. The convalescence was uneventful but the patient did not co-operate in the after-treatment, spoiling what would otherwise have been an excellent result.

On September 16, following manipulation, she gained voluntary extension to 150 degrees. She returned to the outpatient department for massage and manipulation until December, 1919. At this time, she had motion from 75 to 120 degrees and a useful, stable arm.

Case 28. W. M. had fractured his olecranon as the result of a fall. Following an open operation in which the olecranon was fastened in place with silver wire, the elbow gave him no further trouble until a year later following a second injury. When moving a heavy box, a second box had fallen and hit him on the elbow. Two weeks later, when he reported to the hospital, he was in great pain and showed a discharging sinus from which a piece of wire which was protruding was easily removed. Free drainage was established and later the arm was twice curetted. He was discharged March 21 after a tempestuous illness, to report to the out-patient department for dressings. In July, the wounds had healed and the patient was discharged to return in 6 months for an arthroplasty.

This I did on July 9, 1919, and on his discharge from the hospital on September 4, he was able to flex and rotate his arm voluntarily. He is still undergoing treatment and manipulation, baking, and massage. On October 18, 1919, he had voluntary motion from 158 to 105 degrees. On October 30, 1920, he had voluntary motion from 60 degrees to 135 degrees.

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# SECTION OF THE ANTEROLATERAL TRACT OF THE CORD FOR THE RELIEF OF INTRACTABLE PAIN DUE TO SPINAL CORD LESIONS[1]

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THE problem of relieving the pain arising from lesions involving the spinal cord or peripheral nervous system may try the resources of physicians and surgeons alike. The remedy for these distressing conditions is therapeutic or such radical procedures as section of the cord, complete or partial; division of the posterior spinal roots; division of the posterior columns of the cord; section of the pain-conducting tracts in the cord above the level of the disease and extradural operations on spinal roots or ganglia.

What does medicine offer? Therapeutic measures, consisting chiefly of the administration of drugs of the opium group, usually prove unsatisfactory. The condition of the patient becomes pitiable. Deriving only temporary relief, he either becomes addicted to the use of morphine or despairing of relief may attempt suicide.

What does surgery offer? Thanks to the neurologist several measures have been advocated. Although section of the cord has been suggested as a last resort in lesions producing unbearable pain, one can hardly conceive such a measure actually being carried out with all the outcome which a complete paralysis would bring. Division of the posterior roots of the spinal cord for the relief of pain was first suggested by Dana in 1888, and Abbe was the first to report the operation. Since this time numerous root resections are on record and although the operation would appear theoretically sound many failures to attain the desired result have been reported. In 1900, Mingazzini proposed the operation for gastric crises and lancinating pains of tabes. But it was not until 1908 that Foerster first reported the operation for this disease. The result of operation in a large series of these cases has not been entirely satisfactory. "In 1910 A. Schuller suggested that as a substitute operation partial division of the spinal cord might be employed, instead of section of the posterior roots for spasticity either alone or with the direct cerebellar tract; the anterolateral column might be cut for gastric crises. He reported no cases in which this operation was performed and he advised it for these two conditions."

A notable contribution to this subject was made by Spiller in 1912. He proposed employing the method of dividing the anterolateral tract of the cord for the relief of persistent pain of organic origin independent of gastric crises, and with Martin published the result of the first case illustrating this procedure. The operation was performed by Martin, January 19, 1911. Since then the operation has been performed by Beer, Foerster, Elsberg, and Frazier who recently published his results in 6 cases.

A brief abstract of the recorded cases are here included.

Spiller and Martin. J. Am. M. Ass., 1912, lviii, 1489. Patient had an inoperable tumor of the lower part of the spinal cord from which he suffered severe pain in both legs for 2 years previous to operation. At the suggestion of Spiller a division of each anterolateral tract was made by Martin, January 19, 1911. The laminæ and spinous processes of the sixth, seventh, and eighth thoracic vertebræ were removed. Two months later it was noted that the operation seemed to have been successful in diminishing the pain.

Beer. J. Am. M. Ass., 1913, lx, 267. Metastatic carcinoma in pelvis originating from the cervix uteri, which was removed 15 months previously. Severe pain in right leg which caused the patient to draw up the leg. A stovaine injection into the spinal canal was made with complete temporary relief of all pain. He advises this procedure on the ground that if the injection does not produce relief, the operation is contra-indicated for self-evident reasons. On July 2, 1912, a laminectomy with removal of the ninth and tenth thoracic laminæ was made and the left anterolateral column was sectioned. Twelve days after operation the patient was up walking about, all pain in the right lower extremity was gone, and no vestige of it was felt since operation. Some pain developed later in left side and back but to day of her death patient was free from pain in right side.

[1] Read before the Western Surgical Association, Los Angeles, December [illegible], 1913.

Foerster. Surgery of the Spinal Column by Frazier, p. 910. At Foerster's suggestion Tietze performed a section of the lateral column on a patient who had previously had a root resection for gastric crises in which posterior roots from the sixth to twelfth thoracic had been cut. Pains which became unbearable appeared in the left leg. An attempt to section the lumbar roots was found impossible because of adhesions, and section of the anterolateral columns was decided upon. Following this the pain entirely disappeared.

Elsberg. Diseases of the Spinal Cord and Its Membranes by Elsberg, p. 164. Reference to, but no abstract of, the operation is given.

Frazier. Arch. Neurol. & Psych., iv, 137.

Case 1. The patient had an inoperable sarcoma of the spine at the level of the second and third lumbar vertebræ. Suffering was intense and uncontrolled by morphine. Chordotomy was employed with section of the anterolateral column, right and left, at the level of the first lumbar segment. This resulted in total loss of thermal and pain sensation.

Case 2. The patient had a gunshot wound of the spine with intense pain in the left lower extremity. Four grains of morphine a day were given with only partial relief. Unilateral chordotomy was performed and resulted in complete cessation of pain. There had been no recurrence at the last observation, 12 months later.

Case 3. The patient had carcinoma of the rectum, with pain in the rectum, buttock, and thighs. Colostomy and section of the anterolateral column, left and right, were performed. Complete loss of thermal and pain sense on one side only resulted. Radiumtherapy was employed for the carcinoma. Four years later the patient reported himself free from discomfort; presumptive recovery.

Case 4. The patient had an inoperable sarcoma of the thigh with pelvic metastasis and insufferable pain in the gluteal region. The anterolateral columns of the cord were sectioned with relief from pain from the time of the operation until the patient's death, months later.

Case 5. The patient had received a gunshot wound of the spine, and suffered pain in both lower extremities. Chordotomy was performed with loss of pain and temperature sense.

Case 6. The patient had received a shell wound of the pelvis with injury to the sciatic nerve. He had had intense unbearable pain in the thigh and foot for two and a half years, unrelieved and unabated. The anterolateral columns were sectioned with absolute relief. There was recurrence of pain much more moderate, several months later.

## SELECTION OF THE SEGMENT OF CORD FOR OPERATION

In the language of Frazier, "the question of segmental selection is a matter of some concern. We assume that the lesion does not involve the upper extremity. Manifestly, the section could not be made sufficiently high, that is, several segments above the origin of the brachial plexus, with any degree of safety. We assume that the lesion is in the pelvis or involves the spinal column not above the lesion so as to ensure the crossing of all afferent tracts and to allow for the extension of the growth upward, it would be well to add two or three segments. So much for the physiological or anatomical grounds. From the practical or technical point of view, I have selected the sixth thoracic segment as the most convenient for all lesions not higher than the ninth or tenth segments." In his book on *Surgery of the Spinal Cord*, Frazier suggests that the fourth, fifth, or sixth thoracic segment should be selected as this level would be appropriate not only for the relief of pain in the lower extremity but for the relief of gastric crises.

## DESCRIPTION OF THE OPERATION

In this operation as in all surgical procedures a knowledge of the anatomy and physiology of the spinal cord is essential. The cord is exposed in the region of the fourth, fifth, or sixth thoracic segments by the usual laminectomy. Removal of two laminæ is as a rule sufficient for the proper exposure of the cord. The dura having been opened the dentate ligament is identified, grasped with a mosquito forceps, and severed from the dura. Traction on this ligament will rotate the cord so that the anterolateral tract may be readily exposed. A small von Graefe knife with its back toward the dentate ligament is inserted just in front of the ligament and passed to a depth of 2.5 millimeters and brought out behind the origin of the anterior roots, making an incision approximately 2.5 millimeters deep by 3 millimeters wide. The section may be unilateral or bilateral depending on the nature of the lesions. Bleeding is usually slight following the section. A stovaine block may be employed previous to the section by placing a pledget of cotton saturated with 0.4 stovaine solution on the cord above the level of the section. Following the section the dura is closed and the laminectomy wound sutured in layers.

POSTOPERATIVE TREATMENT

Following the operation careful nursing must be carried out as the patient has lost both pain and temperature sense if the operation has been correctly done, and the patient must also be warned of this particular. In all of my cases a hyperæsthetic zone at the level of the divided segment has been noticed. Pain at this level may be so severe as to require an opiate to relieve it.

The phenomena of bowel distention, constipation, bladder tenesmus with retention, symptoms not unusual in laminectomies, were present in all my cases. These symptoms, however, disappeared within a short time.

Only a brief summary of my operations is here given as a more extensive neurological report will be made later.

Case 1. Referred by Dr. Romeiser of the Neurological Service, St. Louis City Hospital. W. J., age 34, a poorly developed and nourished man, had suffered from tabes for past 6 years. He has all the classical signs of tabes; Argyl-Robertson pupils, absent knee-jerk, muscular inco-ordination, trophic ulcers, etc. His blood and spinal fluid gave a positive Wassermann. He had pain in right side of trunk and involving leg. The pain has been so severe that the patient has attempted suicide four different times. He has become addicted to use of morphine. The patient was seen in consultation with Dr. Romeiser who had advised a root resection but on account of the extensive root resection necessary it was decided to divide the anterolateral column.

*Operation, August 24, 1920.* Through a laminectomy of the fifth, sixth, and seventh laminæ the cord was exposed. Because the right side of the body alone was involved only a unilateral section of the anterior column was attempted. The operation was performed as outlined above.

*Postoperative notes.* A painful, hyperæsthetic area appeared below the costal margin, probably due to the irritation of the cord at the corresponding segment, which required morphine for several days. There was some bladder tenesmus, retention, and incontinuence of urine at times. Diarrhœa persisted for 3 weeks. Pain disappeared from the right leg immediately following the operation. He occasionally complained of pain on left side of body. I believe a bilateral section should have been done.

Case 2. Referred by Dr. Romeiser. P. B., a poorly nourished white male, age 32, received an injury to his spine in a railroad accident 8 years ago. Immediately following his injury a laminectomy was done at the level of the ninth, tenth, and eleventh thoracic vertebræ and a spicula of bone removed from the cord. Two years later Dr. Chaddock advised a section of the posterior roots which was attempted, but owing to the trauma, incident to the previous operation or injury, the nerve roots could not be identified and nothing was done. There is present incomplete paralysis of both legs with atrophy of muscles. The patient complained of severe pain in abdomen and lancinating pains in both legs. He requires morphine constantly. On advice of Dr. Romeiser a laminectomy was carried out September 8, 1920, by removing fifth, sixth, and seventh laminæ and a bilateral section of the anterolateral columns was made at level of sixth thoracic segment.

*Postoperative notes.* Pains in both legs have disappeared. For 2 weeks there was uncontrollable vomiting and during the second week some diarrhœa lasting 2 weeks. Tenesmus was present in bowels and bladder. A hyperæsthetic zone can be demonstrated at the tenth and eleventh segments. Pain and temperature sensation are absolutely abolished in both legs below the level of twelfth thoracic segment. There has been decided improvement in this patient. No opiate is required and he is much benefited by the operation.

Case 3. Referred by Dr. Unterberg. Mrs. W. has been a sufferer from tabes for 20 years with more or less pain during this time. For the past 2 years she has not been free from pain a single day. She has been under the care of several neurologists. She has all the classical symptoms and signs of tabes with gastric crises and lancinating pains in both legs. On September 11, 1920, the fifth and sixth thoracic laminæ were removed by the usual laminectomy and the cord exposed. The presence of an old leptomeningitis was revealed which rendered the exposure of the lateral columns difficult. With careful search a point was selected and division of the anterolateral column made.

*Postoperative notes.* On arousing from the anæsthesia she said her legs felt like a new-born baby's. She was entirely unconscious of them except for her ability to move them. Loss of pain sensation was complete in both legs. The same hyperæsthetic area below the costal margin appeared, which required an opiate to relieve it. Bladder and bowel distention were marked and tenesmus of the bladder was very annoying. She was up and about in 2 weeks and did her own housework. She recently had a painful spot appear below the right scapula. The result from this operation was most satisfactory for relief of pain in body and legs. On account of the plastic meningitis found it would have been better if section of the posterior roots in the field of operation had been made.

Case 4. Referred by Dr. Unterberg of the Alexian Brothers Hospital, and operated upon through the courtesy of Dr. Carrol Smith. M.D., age 46, a paper-hanger has been a sufferer from tabetic crises for past 10 or 12 years. He is blind in left eye, he had staggering gait during past 6 months. He had shooting pains in both legs for years. On October 22, 1920, a section of the anterolateral

columns was done, through a laminectomy at level of fifth, sixth, and seventh laminæ, preceded by a one-half per cent stovaine block.

*Postoperative notes.* There was very little disturbance following the operation. The patient was free from pain for several days and did not require any opiate. Says that he has occasional pain in feet. The neurological report has not been returned. Patient left hospital November 18, 1920. The patient's condition seemed much improved. All of the spinothalamic fibers apparently were not divided in this case.

## CONCLUSIONS

From my experience in four cases I believe it has been shown that the operation will produce a permanent relief in any lesion below the thoracic level. In the cases of gastric crises I believe that the section will have to be made higher than the sixth thoracic segment, and see no reason why it should not be made as high as the second or third thoracic. I would also add to the operation section of the posterior nerve roots which are present in the field, as this would destroy sensory impulses which reach to a higher level and are not touched in the section of the anterolateral columns since this section includes only pain impulses which have crossed to the spinothalamic tract below this level. The researches of Head and Pilz would seem to show that pain and temperature fibers require four to six segments for their complete crossing in the cord. If this is so, the section of the several nerve roots which present in the field would seem to enhance the value of the operation especially in the tabetic case with pain involving the trunk. The removal of four laminæ instead of two and removal of four posterior roots would bridge the gap not included by the section of the anterolateral columns. I believe that a bilateral operation should be done in all tabetics; in inoperable tumor of the cord or such cases as reported by Beer of metastatic pelvic tumors.

The advice of Spiller that the incision of the cord might be carried forward even including the anterior horn or motor root in the thoracic region would appear to be a good one as little harm could be produced by it. The greatest danger is in cutting too far posteriorly and thereby injuring the pyramidal tract.

The operation while a delicate one is not difficult to perform, if one will familiarize himself with the subject. It should not be employed recklessly but only after due consideration and in consultation with the neurologist.

# BONE ATROPHY

## An Experimental and Clinical Study of the Changes in Bone which Result from Non-Use

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### INTRODUCTION

THE fact that changes take place in the bones of the extremities when they are not used is generally known. The exact nature of these changes has not been clearly defined.

It has long been appreciated that the bones in an extremity which has not been used, due to paralysis, inflammatory disease, or injury, become lighter, more permeable to the roentgen-ray, and more fragile (1). These changes have often been attributed to the direct effects of trophic influences or inflammatory processes(2). When associated with injury alone, the assumption that non-use plays the important rôle in the causation of these changes has been made, but in these cases the emphasis has been laid on the changed arthitecture of the affected bones rather than on the changes in the bones as a tissue. The apparent complexity of bone as a tissue is simplified if it is regarded as a special type of connective tissue, composed of cells, and an intracellular matrix. The density, permeability, and strength of bones are properties of the matrix alone. Growth and regeneration are obviously properties of the cells alone. It, therefore, follows that changes in the matrix of bone need not necessarily influence its power of growth or regeneration. It is recognized that non-use during the period of growth results in diminution of the normal increase in length and thickness of the bones; but that complete lack of use does not result in complete cessation of growth of bone. It has not been clear, however, what difference there is between a bone that has not been used during the period of growth and one that has been affected by non-use after growth has been established.

Bone regeneration is a process which must be considered independently of the process of bone growth. The later process is confined to a definite period of life, and is associated with the processes of the entire organism. The former process may function at any period of life and is an intrinsic property of the bone as a tissue. It has not been known what relationship there is between bone atrophy and bone regeneration.

The apparent complexity of bone as a substance is simplified if it is regarded as composed of water, organic material, and mineral salts. The weight in part and the permeability to X-ray wholly depend upon the mass of mineral constituents in the bone. It is clear that a bone may become lighter, more fragile, and more permeable to X-ray as a result of diminished bone mass, or on account of a change in its chemical composition. The mass of mineral salts in a bone may be diminished either by a lessening of the volume of bone substance, or by a lessening of the proportions of mineral salts in the bone with no change in volume.

It has not been determined before which of these two conditions is responsible for the diminished weight and strength and the increased permeability to X-ray of bones which have not been used.

The purpose of this experimental and clinical study is to determine the effect of non-use of bones as it concerns:

1. X-ray photographs;
2. Gross and microscopic anatomy;
3. Chemical composition;
4. Breaking strength;
5. Growth; and
6. Regeneration.

### EXPERIMENTAL METHOD

Dogs were used for the experiments. Three methods were employed to prevent use of the foreleg.

a. Section of the brachial plexus, resulting in partial or complete paralysis—13 experiments.

b. Excision of upper end of humerus, resulting in a flail joint—7 experiments.

c. Plaster-of-Paris fixation—4 experiments.

In each group of experiments the results of non-use for varying periods of time were studied. When the experiments were terminated the bones of both forelegs were compared by X-ray examination, measurements, weights, and as to chemical composition and breaking strength.

For the study of the effect of non-use on regeneration, the following method was employed. The animals in which one foreleg had been subjected to varying periods of non-use by the methods used, were operated upon again. This operation consisted of removal of a section of each ulna. The defect in the atrophied ulna was bridged by a transplant of bone with periosteum and marrow from the non-atrophied ulna. The defect in the non-atrophied ulna was bridged by a similar transplant from the atrophied ulna. This operative procedure gave in each animal two transplants in similar defects in each ulna. One transplant was atrophied bone placed in an extremity which was used. The other transplant was non-atrophied bone placed in an extremity which was not used. The results of these experiments were studied by means of the X-ray and macroscopic examinations.

In one experiment, No. 12, the transplants were not transposed. In this instance the defect in the ulna of the non-used extremity was bridged by an implant of atrophied bone, and the defect in the ulnæ of the used extremity was bridged by an implant of normal bone. In another experiment, No. 17, simple fractures were produced in the ulna of the used and non-used extremities.

These experiments showed changes in the bones which were the same in each of the methods used for producing non-use.

1. *Changes in X-ray photographs due to non-use.* A study of the X-ray photographs of the bones of the non-used forelegs reveals changes which are the same as are observed in the bones of a human extremity which has not been used. The earliest change observed as is shown in the experiments of shortest duration (7 to 30 days) took place in the cancellous extremities of the bones. The shadows of the trabeculæ became less defined, producing an effect suggesting imperfect radiographic technique (Fig. 2). In addition to the general lack of definition of the bone trabeculæ there are irregular areas in which the trabeculæ have disappeared entirely (Fig. 3).

In experiments of longer duration (30 to 100 days) a well marked change made its appearance in the compact bone of the shaft. This change was a decrease in the diameter of the shaft of the bone, an increase in the diameter of the medullary canal, the result of which was a cortex of diminished thickness (Fig. 4).

In the experiments of longest duration (100 to 314 days), the trabeculæ are well defined but very small and relatively very few in number. The compact bone of the shaft is further diminished in thickness and shows longitudinal striæ of diminished density (Fig. 5).

2. *Changes in gross and microscopic anatomy due to non-use.* The initial changes in gross anatomy of the bone due to non-use of an extremity are the same regardless of the age of the individuals. The ultimate result of the changes in gross anatomy of the bones of an extremity which is not used is different in the individual who has reached his complete growth, from that in the individual who is in his growing period at the time of onset of non-use. In the former instance, the process of bone atrophy is operating alone. In the latter, the process of bone atrophy is associated with the process of growth which is inhibited but not arrested by non-use. In this study both growing and adult dogs were used in experiments of relatively short duration (10 to 200 days). In the experiments of long duration (200 to 314 days) only adult dogs were used. However, the ultimate changes in the gross anatomy of the bones due to experimental non-use of an extremity beginning before the completion of growth are shown in the illustrations and measurements of Howell (3), and the effects of poliomyelitis, tuberculosis of bone, and congenital or acquired deformities in childhood give abundant opportunity for the study of these changes. The first change noted on the

TABLE I.—RESULT IN EXPERIMENT 26

| | Weight Fresh | Weight Dry | Weight of Ash | Water per cent | Organic Matter per cent | Mineral Matter per cent |
|---|---|---|---|---|---|---|
| Used humerus | 4.8 g. | 0.0 g. | 2.85 g. | 51.2 | 28.7 | 24.1 |
| Non-used humerus | 4.7 g. | 3.1 g. | 2.02 g. | 56.4 | 26.4 | 17.2 |
| Difference | 0.6 g. | 2.9 g. | 0.83 g. | −5.2 | +0.7 | −6.9 |

TABLE II.—RESULT AFTER 195 DAYS IN EXPERIMENT 5

| | Water per cent | Organic per cent | Inorganic per cent |
|---|---|---|---|
| Compact bone of used ulna | 13.6 | 32.7 | 53.4 |
| Compact bone of non-used ulna | 16.2 | 31.4 | 52.3 |
| Difference | 0.6 | 1.3 | 0.9 |

examination of a bone of an extremity which has not been used is in the relationship between the periosteum and the compact bone of the shaft. In normal bone, the periosteum strips from the bone with ease leaving a smooth, glistening surface. In atrophied bone, the periosteum strips from the bone with difficulty and leaves a surface which has the feel of fine sand-paper. The cancellous extremities of the bone are much more fragile and on section show fewer and smaller trabeculæ and a marrow containing increased amount of fat. Section of the shaft shows a cortex of diminished thickness with an enlarged medullary canal.

After relatively short periods of non-use (10 to 100 days) in individuals of all ages there are constant differences in the comparative measurements of the bones of the used and non-used extremities. The diameter of the shaft is diminished. The diameter of the medullary canal is increased. The increase in the diameter of the canal is greater than the decrease in the diameter of the bone (Fig. 1, Fig. 6). The cortex is diminished in thickness from both surfaces but proportionately more from the marrow surface. After relatively short periods of non-use also in adult dogs, there is no demonstrable difference in the length of the bones, comparing used with non-used extremities. In growing dogs, the bones of the non-used extremity, after short periods of non-use, may be slightly shorter than the bones of the used extremity but growth in length of bones is only retarded to a sufficient extent so that it is manifest after comparatively long periods of non-use.

TABLE III.—RESULT AFTER 250 DAYS IN EXPERIMENT 5

| | Used Bone | Non-Used Bone |
|---|---|---|
| Weight [illegible] | 18.11 grams | 18.70 grams |
| Volume [illegible] | 12.3 c.cm. | 11.8 c.cm. |
| Specific gravity of entire bone | 1.47 | 1.58 |
| Weight [illegible] | 1.18 grams | .85 gram |
| Weight [illegible] | 16.66 grams | 17.09 grams |
| Weight of mineral matter of sample of [illegible] | 0.727 gram | 1.05 gram |
| Weight [illegible] | .83 gram | .71 gram |
| Weight of mineral matter in entire [illegible] | 6.05 grams | 8.5 grams |
| Proportion of mineral matter in sample [illegible] | 59.7 per cent | 57.8 per cent |
| Proportion of mineral matter in entire [illegible] | 36.3 per cent | 45.4 per cent |

The ultimate effect of non-use for a long period on the bone of an adult is that the initial changes already described are much more marked. A further change becomes evident. This change is in the character of the cortical bone of the shaft which loses its compact structure and becomes porous (Fig. 7). This porosity of the bone explains the linear striæ of the shafts seen in roentgenograms (Fig. 8). It is to be emphasized, however, that none of these changes affect to any marked degree the general shape and contour of the bone as a whole. The diameter of the shaft is only slightly decreased and the length is not changed. In a bone, after a long period of non-use during growth, there is a very striking difference in shape as compared with the corresponding bone of the used extremity. The bone is smaller both in length and thickness; the decrease in thickness is more noticeable than that of length. Furthermore, the diminution in thickness is more marked in the shaft than in the epiphysis, producing an effect of sudden enlargement at the epiphyseal regions (Fig. 9). The periosteum strips from the bone normally. On cross section of the shaft the thickness of the cortex relative to the diameter of the bone shows a change

TABLE IV.—COMPARATIVE BREAKING STRENGTH OF METACARPAL BONES OF EACH FOOT, EXPERIMENT I

| Bone | Used Bone | Non-Used Bone |
|---|---|---|
| Second metacarpal | 21,200 grams | 7,100 grams |
| Third metacarpal | 24,000 grams | 7,000 grams |
| Fourth metacarpal | 21,300 grams | 6,000 grams |
| Fifth metacarpal | 18,000 grams | 9,000 grams |

TABLE V.—EXTREME FIBER STRESS

| | Thickness (h) | Breadth (b) | Distance between supports (l) | Load (w) | Extreme Fiber Stress |
|---|---|---|---|---|---|
| Cortex of used humerus | 2.35 mm. | 3.41 mm. | 25 mm. | 6,000 gm. | 12,000 per sq.mm. |
| Cortex of non used humerus | 1.51 mm. | 3.39 mm. | 35 mm. | 3,100 gm. | 15,000 per sq.mm. |

which is small as compared to that seen in bone atrophy occurring during adult life. Comparative measurements of the thicknesses of the entire bones and the diameters of the medullary canals show that the medullary canal of the non-used bone is always larger relative to the thickness of the same bone although it may be actually smaller than the medullary canal of the corresponding bone of the used extremity. There may also be a difference in the shape of the cross section of the bones, comparing used with non-used; for

TABLE VI.—EFFECT OF NON-USE ON REGENERATION OF BONE DUE TO NON-USE

| No. of Exp. | Age of Animal | Method of Producing Non-use | Duration of Non-use before Transplantation | Duration after Transplantation | Method of Testing Regeneration | Degree of Bone Atrophy[1] | Regeneration Observed in Used Extremity[2] | Regeneration Observed in Non-used Extremity[2] | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 18 | Adult | Brachial plexus cut | 32 days | 101 days | Transposition of transplants | + | − − − + | − − − + | Fig. 18, Plate I. |
| 1 | Young | Brachial plexus cut | 35 days | 113 days | Transposition of transplants | + | +++ | ++++ | Fig. 1, Plate I. |
| 6 | Young | Brachial plexus cut | 39 days | 80 days | Transposition of transplants | − + | − + − | − − + | Fig. 6, Plate I. |
| 7 | Adult | Brachial plexus cut | 39 days | 137 days | Transposition of transplants | + − − | + − − + | ++++ | Fig. 7, Plate I. |
| 13 | Adult | Brachial plexus cut | 43 days | 115 days | Transposition of transplants | + | − + + | − − + | Fig. 13, Plate I. |
| 2 | Old | Brachial plexus cut | 188 days | 116 days | Transposition of transplants | + + − Both extremities | + | − − | Animal fractured radius in used extremity, both extremities showed impaired function. |
| 4 | Adult | Brachial plexus cut | 105 days | 119 days | Transposition of transplants | ++ | +++ | +++ | Fig. 4, Plate I. |
| 5 | Adult | Brachial plexus cut | 195 days | 61 days | Transposition of transplants | ++++ | +++ | +++ | Fig. 5, Plate II. |
| 17 | Adult | Excision of humeral head | 79 days | 57 days | Fractures of both ulnæ | − + − | + − − + | ++++ | Callus about fractures in non-used extremity larger, but is more permeable to X-ray. Fig. 17, Plate II. |
| 11 | Adult | Excision of humeral head | 47 days | 91 days | Transposition of transplants | +++ | − + | ++ | Fig. 11, Plate II. |
| 3 | Adult | Excision of humeral head | 37 days | 77 days | Transposition of transplants | + + + | O | + | Fig. 3, Plate II. |
| 10 | Adult | Brachial plexus cut and head of humerus excised | 32 days | 140 days | Transposition of transplants | + + − | ++++ | ++++ | Fig. 10, Plate II. |
| 12 | Adult | Brachial plexus cut | 47 days | 117 days | Transplants not transposed | ++ | + − + + | ++++ | Fig. 12, Plate II |

[1]Explanation of − signs, Atrophy.
+, Slight atrophy.
++, Moderate atrophy.
+++, Marked atrophy.
++++, Extreme atrophy.

[2]Explanation of + signs, Regeneration.
++++, Complete regeneration of defect in bone.
+++, Transplant regeneration, united at one end.
++, Transplant regeneration, neither end united.
+, Slight regeneration.
O, No regeneration, transplant being absorbed.

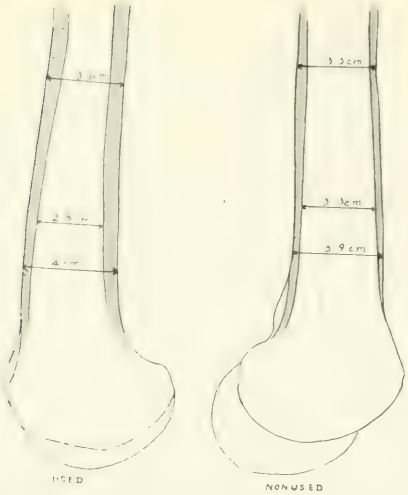


Fig. 1. Tracings of roentgenograms of the distal ends of the femora, showing slight decrease in the diameter of the bone and marked increase in the diameter of the medullary canal as a result of non-use following amputation.

example, the cross section of a normal used tibia is triangular in outline while the cross section of a tibia which has not been used during the growing period more nearly approaches a circle. (Compare Figures 7, 10, and 11.)

Microscopical sections of the epiphyses and shafts of used and non-used bones of each experiment were compared. Examination of these sections shows the same alterations as are evident on macroscopic study.

In both normal and atrophied bones there are evidences of bone absorption and bone regeneration.

The sections of atrophied bone show all stages of the process of atrophy as indicated by the diminishing number and size of trabeculæ, the decreasing thickness of the compact bone, and the accumulation of fat in the marrow, and ultimately the increased porosity of the compact bone (Fig. 12).

In none of the sections studied was it possible to observe the exact nature of this process.

3. *The changes in chemical composition of bone due to non-use.* The changes in the relative proportions of water, organic and inorganic matter in bone as a result of non-use is illustrated by the following described experiments.

*Experiment 26.* The brachial plexus of a young dog was divided. After 24 days of complete paralysis the animal was sacrificed and the humeri of both used and non-used extremities were removed. The bones were weighed in fresh state, after drying at 100° C. and after incineration. The results are shown in Table I.

*Experiment 5.* The left brachial plexus of an adult dog was divided. After 195 days a piece of the cortex of each ulna was removed, cleaned of soft parts and weighed fresh, dry and after incineration. The proportion of water, organic and inorganic matter is shown in Table II.

At the end of 256 days the animal was sacrificed and the humeri of both used and non-used extremities were removed.

X-ray examination showed marked atrophy of the non-used bone.

The weight and volume of each bone was determined. From the shaft of each humerus a portion of the compact bone was removed, cleaned of soft parts, and weighed fresh and after incineration. The remainder of each bone was weighed fresh and incinerated. The results are shown in Table III.

The results of these experiments show that non-use has no effect upon the chemical composition of the bone matrix. The proportions of water, organic and inorganic material in the bone as a whole are changed to marked degree by non-use for even comparatively short periods of time. It is evident from Experiment 26 that an entire bone may lose more than one-quarter of its mineral constituents during 24 days of non-use. In Experiment 5, when the non-use had existed for 195 days and there had been a marked diminution in the thickness of the cortex of the shaft, it was found that there was no appreciable difference in the chemical composition of this cortical bone when compared with the cortical bone of the used extremity.

It, therefore, follows that the loss of mineral constituents due to non-use of a bone is a loss of bone matrix rather than a loss of mineral constituents of bone matrix.

In other words there is, as a result of non-use, less bone matrix present rather than any change in the character of the bone matrix

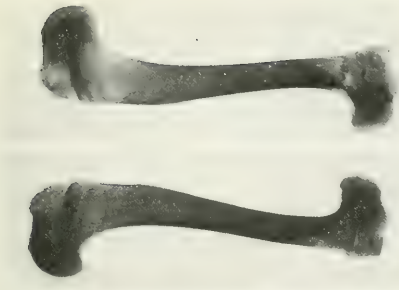

Fig. 2. Roentgenogram of humeri of used (below) and non-used (above) extremities 24 days after section of the brachial plexus, showing less definition of the bone trabeculæ of the non-used humerus. Experiment No. 26.

The change is quantitative rather than qualitative.

It is obviously impossible to determine the chemical composition of the matrix of spongy or cancellous bone independent of the marrow tissue it contains. It is likewise impossible to determine accurately the composition of the matrix of the cortical bone of the shaft in case this bone becomes porous. Thus in Experiment 5 when the non-use had continued for 256 days there was found a small difference in the proportions of mineral constituents in the cortical bone of the used and non-used shafts. The difference was due to the fact that the cortical bone of the non-used extremity was more porous and, therefore, the sample analyzed contained more of marrow-like tissue.

4. *The effect of non-use on the strength of bones due to non-use.* The relative resistance of materials to external force is determined by various methods according to the effects on the material of the applied force; for example, compression strength, bending strength, torsion strength, breaking strength, etc., etc.

The simplest and most accurate method of estimating the relative strength of bones is to determine the minimum force which will break the bone when the bone is resting on two horizontal supports and the force is applied as an increasing weight at a point equidistant from the two supports.

Fig. 3. Roentgenograms of humeri and radii of used (above) and non-used (below) extremities 7 days after section of brachial plexus, showing in tuberosity of humerus and head of radius of non-used bones areas in which the trabeculæ have disappeared. Experiment No. 9.

For the determination of the comparative breaking strength of the bones in these experiments, a simple apparatus was used in which the horizontal supports were constantly 25 millimeters apart and the increasing weight applied at the point mid-way between the supports was obtained by hanging a container from this point and adding sand until the bone broke. The sand was then weighed. In each experiment the breaking strength of the bones of the used and non-used extremities was determined.

The results obtained are illustrated in the following experiment.

*Experiment 1.* Left brachial plexus cut in an adult dog, resulting in a complete paralysis of the foreleg. At the end of 113 days the animal was sacrificed and the bones were removed from the two extremities. X-ray examination of bone showed marked atrophy of bones on the left side (Fig. 13). The comparative breaking strength of the metacarpal bones of each foot is shown in Table IV.

From this table it is evident that there is a marked difference in the breaking strength of the bones of the used and non-used extremi-

Fig. 4. Roentgenogram of the bones of used (above) and non-used (below) extremities 110 days after excision of the head of the humerus, showing diminished thickness of cortex of the shafts of the bones of the non-used extremity. Showing also the results of transplantation. See Table VI and Plate II, Experiment No. 3.

ties. The figures given are the breaking strength of the whole bones. It is obvious that the breaking strength of the shaft of a bone depends on the shape and area of the cross section. It has already been shown that in the bones of non-used extremities there is a decrease in the diameter of the shaft as a whole and an increase in the diameter of the medullary canal. The breaking strength of a bone may also be affected by a change in the character of the bone matrix. In order to determine if the decrease in breaking strength of the whole bone is due entirely to changes in shape and area of the cross section, or to

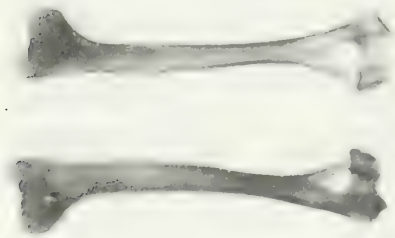

Fig. 5. Roentgenogram of the humeri of the used (below) and non-used (above) extremities 256 days after section of the brachial plexus, showing extreme atrophy of bone.

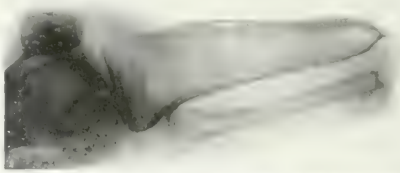

Fig. 6. Roentgenogram of the bones of an amputation stump showing extreme atrophy. The effect of non-use as after growth was established. Compare Figure 5.

Fig. 11 Fig. 7 Fig. 10

Fig. 7. Photograph of a cross section of the non-used tibia shown in Figure 8. Natural size.

Fig. 10. Photograph of a cross section of a tibia which was not used during the period of growth. The roentgenogram is shown in Figure 9. Natural size.

Fig. 11. Photograph of a cross section of the normal adult tibia, shown for comparison with Figures 7 and 10. Natural size.

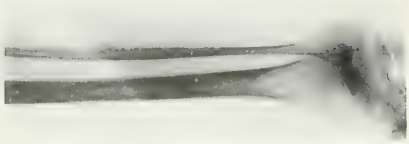

Fig. 9. Roentgenogram of the bones of the leg of an adult which had not been used since early childhood as a result of tuberculosis of the femur. See Figure 10.

intrinsic changes in the bone matrix, a rectangular piece of cortex from the shaft of the humerus, the cross section area of which could be accurately measured, was prepared from the used and non-used extremities. The breaking strength of these specimens was determined by the method already described. The breadth and thickness at the breaking point were measured with a micrometer caliper. The "extreme fiber stress" was obtained by substituting these values in the general formula applicable to rectangular beams on two supports with the load in the middle.

$$F = \frac{3\ W\ l}{2\ b\ h^2}$$

Table V shows the results obtained.

These results show that although the cortex of the non-used bone supported only about one-half the load supported by the cortex of the used bone, nevertheless if the load per unit of the cross section is considered, the extreme fiber strength of the two bones is equal within the limit of experimental error.

It follows, therefore, that the bones of a non-used extremity break more readily owing to a diminution in the thickness of the bone rather than to any change in the nature of the bone substance.

6. *The effect of non-use on regeneration of bone due to non-use.* The most accurate method of determining the power of regeneration of a bone is by observing the regeneration of a transplant removed from this bone and placed in a bone defect.

By the experimental methods described three types of transplants were obtained. First, bone transplants were removed from bone which had become atrophied owing to non-use of an extremity and placed in defects in normal bone in an extremity which was used. Second, transplants were removed from normal bone and placed in extremities

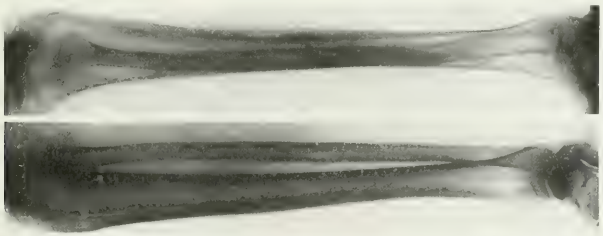

Fig. 8. Roentgenograms of the bones of the legs of a woman aged 42 years who had not used one leg in walking for over 6 years as a result of a traumatic deformity of the foot. Note the diminished thickness of the cortex of the shafts of the bones of the non-used leg (above) and the longitudinal striæ of diminished density. A cross section of this bone is shown in Figure 7.

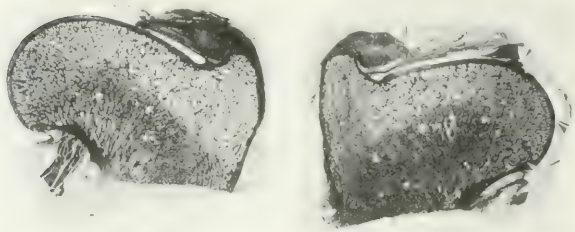

Fig. 12. Photomicrographs of the heads of the used and non-used humeri of a dog 314 days after section of one brachial plexus.

which were not used. Third, transplants were removed from bones which had become atrophied and were placed in extremities which were not used. The period of non-use of the extremity from which the transplant was taken varied from 32 to 195 days. The length of time between the transplantation and the termination of the experiment varied from 61 to 119 days. (See Table VI).

Fig. 13. Roentgenogram of bones of used (at left) and non-used forefeet of a dog 113 days after section of one brachial plexus. The comparative breaking strengths of these metacarpal bones is shown in Table IV.

In experiments Nos. 18, 1, 6, 7, 13, 2, 4, and 5, in which non-use resulted from section of nerves producing paralysis for periods varying from 119 days to 314 days, in which the amount of atrophy varied from slight to extreme degree, and in which regeneration of normal bone in a used extremity, atrophied bone in a used extremity, normal bone in a non-used extremity, and atrophied in a non-used extremity was studied, no difference was observed.

In experiments Nos. 11, 3, 10, and 12 in which non-use was produced by excision of the head of the humerus and in which the same transplantations were studied, there was no difference in the regeneration observed.

In experiment No. 17, in which the healing of simple fractures in used and non-used bones were studied, no difference in regeneration was found.

From the results of these experiments, it is clear that non-use of an extremity has no effect upon the regeneration of its bones. Regeneration is here defined as the ability of a bone to repair a defect caused by injury (Plates I and II).

## DISCUSSION

In these experiments in which non-use was produced by nerve paralysis, injury to joints and simple fixation, the changes observed in the bone were the same.

The degree of atrophy of the bone was directly proportional to the degree of non-use regardless of the method used to produce the non-use. Simple fixation produced as rapidly developing and as marked bone atrophy as

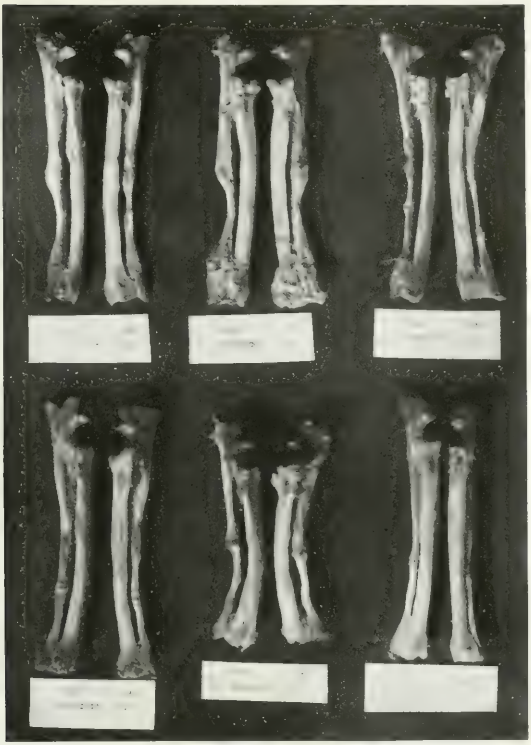

Plate I. Photographs showing the results of the transplantation of bone in used and non-used extremities in Experiments 18, 1, 6, 7, 13, and 4. See Table V.

non-use due to section of nerves or injury to joints. Complete fixation of a dog's extremity is so difficult that this method was not extensively employed. There is no evidence warranting the assumption that any disease process plays any rôle in the production of bone atrophy other than its effect on use. That bone atrophy is not the result of diminished circulation of blood is shown by the fact that bone atrophy rapidly develops in the acute inflammatory diseases which limit the function of an extremity. Also we have observed a patient who had ligation of the popliteal artery and a diminution of blood supply to the leg sufficient to cause a complete ischæmic paralysis and a slowly developing gangrene yet the tibia showed no evident atrophy after a period of 4 months.

Bone absorption is an active process and the circulation of the blood is necessary to its progress. The process of bone atrophy is not a change in the characteristics of bone as a tissue. The process of bone atrophy is not a change in the characteristics of bone as a substance. The process of bone atrophy is a change in the amount of bone present. This

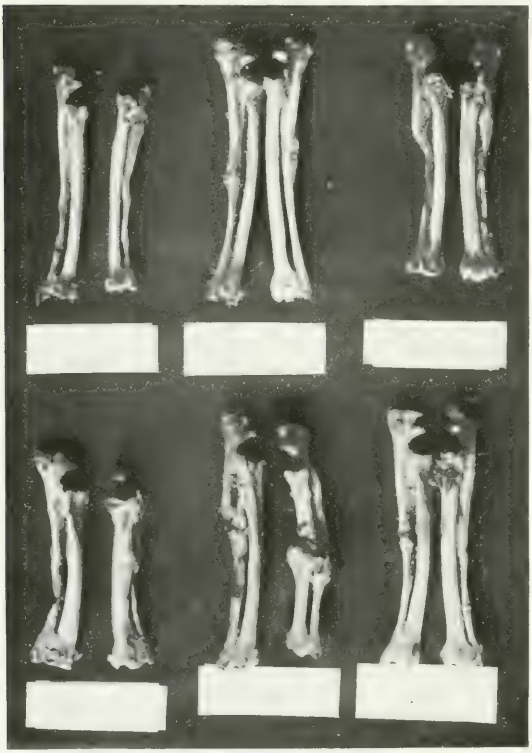

Plate II. Photographs showing bone regeneration in tissue and non-tissue extremities in Experiments 1, 11, 8, 12, and 14. See Table VI.

affects the size, shape, thickness, length, weight, and texture of the whole bone and accounts for its changes in gross anatomy, X-ray photographs, breaking strength, and chemical composition. The chemical composition, breaking strength, and regeneration of *bone* remain unchanged.


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# THE DELAYED TRANSFER OF LONG PEDICLE FLAPS IN PLASTIC SURGERY[1]

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THE loss of a large cutaneous flap intended for the correction of a defect is always at least an embarrassment to the surgeon and often little short of a tragedy to the patient.

The following illustrated record of disaster and near-disaster is given to emphasize one essential risk in this work and to demonstrate a means adopted to lessen the likelihood of such occurrences.

A somewhat extensive observation in the making and transplanting of cutaneous flaps for the correction of superficial defects has led to the following conclusions:

1. That about the neck and face of a man in ordinary health, regardless of age, rather long flaps can be made with little danger to their vitality provided the return circulation is obstructed neither by gravity nor kinking or torsion of the pedicle (Fig. 2), but that in women and children the circulation is not so vigorous and equally long flaps are less likely to survive (Figs. 1, 3, 4, 5, and 10).

2. That in any instance, the chance of success is increased, or a longer flap can be raised, or the flap can be cut narrower and thinner, with equal chance of success if it is first completely raised and then immediately sutured back into its original bed and the transfer to the new position delayed for a period varying from 6 days to 2 weeks.

3. That if a flap does slough in its original bed, the extent of the area lost will be considerably less than if it had been immediately transplanted (Fig. 3).

4. That sloughing of an untransplanted flap is apt to be superficial without destruction of the full thickness of the skin, while a slough occurring after transfer is more apt to involve the full thickness of the flap (Fig. 4, *a* and *b*).

5. That if a flap will not survive, it is a real advantage to have this fact demonstrated before removal of the scar and freshening of the edges of the defect (Figs. 3, 4, and 5).

6. That provision for a possible partial loss can usually be made in the original planning of the flap (Figs. 4, 8, and 9).

7. That in the transplanted position, gravity may be more favorable to venous and lymphatic drainage, but this will not always compensate for other deleterious factors essential to immediate transfer (Fig. 2).

8. That if it becomes evident that the transplanted flap is in danger of sloughing, it

*a* *b*

Fig. 1. Partial slough of a short broad flap in an infant. *a*, The condition at 24 hours, the time of operation. Only the mesial half of the very wide right ala bordering on this oblique facial cleft was used in reconstructing the nostril and though the soft tissues of the right half of the external nose were raised from the nasal bone, they were disturbed in no other way but, in spite of this, it will be seen in *b* (at right), taken 7 days later, that almost all of the right ala has sloughed away.

[1]Presented before the Southern Surgical Association, Hot Springs, Virginia, December, 1920.

Fig. 2. Restoration of a palate by immediate transplantation of a neck flap. *a*, Shows the defect and the neck flap outlined; *b*, shows the neck flap sutured into the palate through an opening in the buccal fornix; *c*, shows the restored palate with the pedicle of the flap returned to the neck; *d*, *e*, and *f*, are photographs showing actual conditions.

Immediate transfer of a flap of this type to a position higher than its base will usually succeed in the adult male, but in a child it will probably fail.

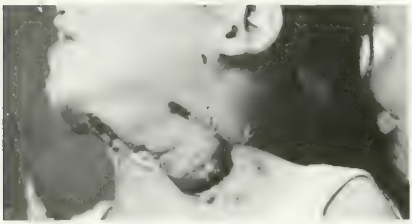

Fig. 3. A sloughing flap. This figure shows a flap that was raised and carried back into the neck with the intention of later transplanting it into a palate defect. No further attempt was made to transplant the flap but the child was saved a great deal by not having the flap placed in the mouth. A previous attempt had been made on the other side immediately to transfer a neck flap to the palate and the whole flap sloughed.

is better immediately to place it back in its original bed. By so doing not only will time be saved but, not improbably, a much larger part of the flap (Figs. 5 to 14, c and d).

9. That when a flap is to be split into two or more narrow flaps, such as to cover the eyelids or lips, or to line the nose, it is safer to delay splitting the flap until the time of

Fig. 4. Palate repair from the neck; delayed transplantation. *a*, Shows the palate in a 10-year-old child, a mass of scar resulting from the development of scarlatina the day after operation for the repair of the palate at the age of 1 year; *b*, shows the slough that occurred after raising a neck flap and suturing t in its original bed preparatory to transplanting it into the palate defect. *d*, taken 30 days later, shows that the skin was completely destroyed in only a part of the sloughed area shown in *b*. It was originally intended to have the base of this flap located near the mid-line under the skin but, after the occurrence of the slough, an incision was made dividing the healthy from the damaged tissue, the latter was left in place and the incisions outlining the flap were extended across under the chin so as to bring the base on to the right cheek. An opening was made through the mucosa and buccinator muscle in the right bucco-alveolar fornix and, after freshening the edges of the palate defect, the tip of the flap was sutured in place. In *c*, the dotted line represents the position of the flap sutured into the palate. After union had occurred, the pedicle was cut and returned to the neck.

transplantation or to an intermediate time rather than to do it at the time the flap is first raised (Figs. 6 and 7).

10. That in a neck flap which includes a section of the clavicle for a pedicle bone graft, the soft tissues will have a firmer attachment to the bone and, I believe, the bone will be more resistant to infection if the transfer is delayed.

11. That a blood clot under a flap that has been sutured back into place may be fatal to the flap. This is avoided by moderate pressure of dressings and use of multiple drains, to be removed in 24 hours (Fig. 12, a).

12. That if there is to be a raw surface left exposed on the pedicle after transplantation of the flap, it will be more

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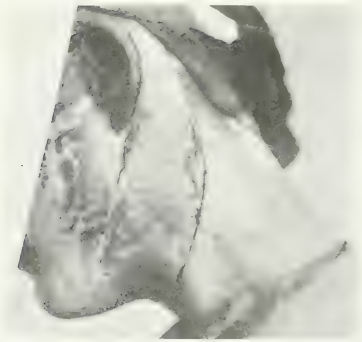

Fig. 5. Attempted palate repair from neck flap; failure in spite of delayed transplantation. A girl of 16 had had several previous unsuccessful attempts to repair the palate. The outlined flap which included the hair-free skin just behind the ear was liberated but left attached at both ends and sutured back in its bed. A slight superficial slough occurred near each border about the middle of the flap. The general discoloration is due to the iodine used at operation. During the period of 10 days following the raising of the flap, the base of the upper pedicle was intermittently compressed each day by a spring until it was believed that the whole blood supply came through the lower pedicle. Then the upper pedicle was cut and the flap again elevated and again sutured back in its bed. Two days later the upper end of the flap was sutured into the palate defect, the resulting neck defect being united with a Wolcott. The tip of the flap was turned back and, the flap was detached from the palate, the slough removed and the pedicle replaced in the neck, as the operation had failed.

Fig. 6. Sloughing flap on the arm of a child. The flap shown here was made on the arm of a 12-year-old boy with the intention of transferring it to the upper lip and the side of the nose on a burned face. The flap was split at the time it was raised and this part sloughed. It was not used.

I believe the lessons to be drawn from case in Figure 5 are that the base of the upper pedicle was made too narrow, that when any part of a flap shows the least inclination to slough this part should not be transplanted, and that 2 days is not long enough to determine the viability of a flap.

Fig. 7. Delayed transplantation of a forehead flap for eyelid repair. *a*, Shows a child with facial burns of peculiar distribution; *b*, shows an outlined forehead flap that was cut very thin and sloughed in its distal part; *c*, shows the later implantation of the flap after splitting it so as to apply to both lids.

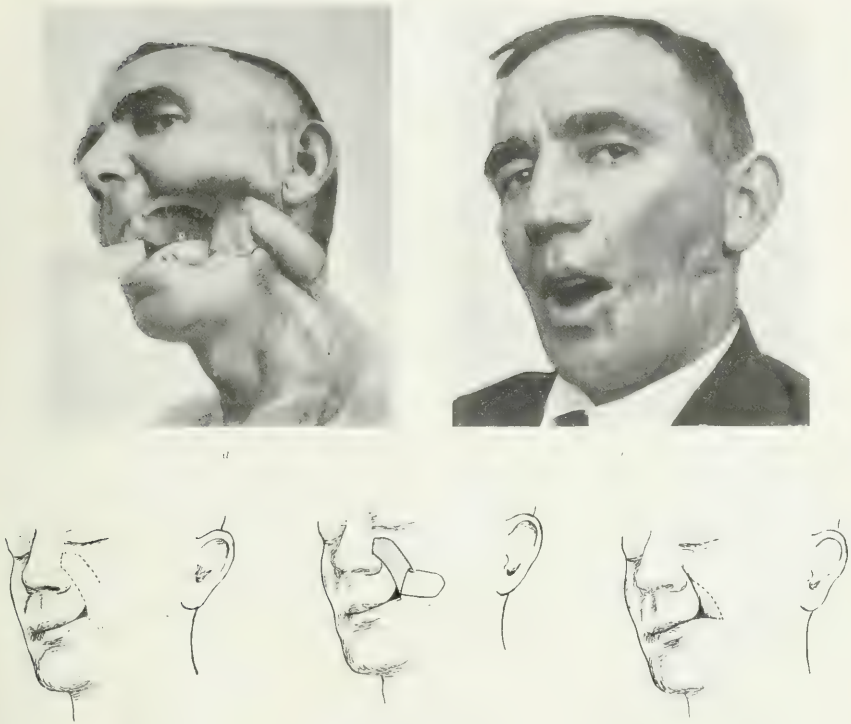

Fig. 8. Repair of pharynx and cheek with a neck flap. Immediate transplantation failed, later transplantation was successful. Following the excision of the mucosa of the cheek, the buccinator muscle, the left tonsil, half of the vellum and part of the pharynx with a cautery for the removal of a widespread, recurrent, carcinomatous verruca, the jaws could not be separated and there was a wide defect in the cheek as shown in *a*. A flap was cut 3 inches wide and 3 inches below the left ear and the tip was taken from in front of the shoulder. The tip was immediately implanted into the defect that remained after the scar was cut from the velum, pharynx, and from between the jaws. Part of the tip of the flap sloughed and part remained attached within the mouth but not enough to permit the jaws to separate, scar having again bound them together. At a subsequent operation, the tip was cut from its attachment within the mouth, the flap lengthened by extending the pedicle upward so that the base was nearer the ear and, after removing the intra-oral and pharyngeal scars, the tip was successfully reimplanted as shown in *a*. At a later period after a new blood supply was established, the pedicle was cut at the base and unrolled, the skin edges were freed from the jaws and the cheek lined by turning the pedicle forward. The anterior end of the pedicle sloughed so that the jaws again became bound together, this time by a scar near the corner of the mouth. To correct this, a flap was taken from beside the nose, *b*, and transferred into the mouth to supplement the cheek lining, shown in *c*. Later the base of the cheek flap was cut across at the dotted line, in *d*, and the pedicle was used to line the left half of the upper lip. *e*, Shows the final cosmetic results and the ability of the patient to open his mouth. The excision of the growth was done 2 years before and there is no sign of a return of the disease.

The successful outcome of the repair in this case was primarily dependent upon the fact that the base of the original flap was so placed that we were able to lengthen it after the tip sloughed. If the transfer of the original flap had been delayed, this would not have been necessary.

Fig. 9.—Nose with cartilages, lining, and columella destroyed by syphilis. The columella was replaced by a flap from the upper lip but this left no breathing space. The floor of each nostril was widened by turning in the flaps outlined in *b* giving the result shown in *c*. To restore the lining of the nose, the forehead flap shown outlined in *d* was cut very thin and sutured back into its bed. A week later the nose was split along the dotted line in *d* and, after cutting out the scar that bound the border of the nostril to the left nasal bone, this half of the nose was lined with the tip of the forehead flap as shown in *e*. Later the pedicled of the forehead flap was cut near its base and used to line the right side of the nose as shown in *f*. *g*, Shows the result in this case.

In a case previously operated upon, immediate transplantation of the forehead flap was attempted, resulting in a partial slough of the tip and the operation had to be repeated by making an entirely new flap because no provision had been made for lengthening the flap as shown in the case illustrated in Figure 8.

Fig. 10. Superficial slough on tip of a flap intended for a lining of the nose. The sloughed part was left in its original place and, after the slough separated, so little of the thickness of the skin had been destroyed that it showed no damage. This was the second attempt to procure a flap to line this nose. The first time an immediate transfer was attempted, followed by a slough of the flap in the nose.

Fig. 11. Immediate transplantation of a flap followed by sloughing. A relatively short flap is shown raised from the neck and transplanted into the cheek to relax scars on the burned face of a 6-year-old child. After raising the flap its color was so good that an immediate transplantation was made in place of a delayed transfer as was first intended. Half of the flap sloughed.

Fig. 12. Delayed transplantation of a long neck and chest flap to the face of a burned child. *a*, Shows the flap which has been raised but left attached at both ends, sutured back into its bed and tubed at its lower end for convenience of intermittent constriction; *d*, *d*, *d*, are rubber dam drains for immediate drainage of serum; *g*, is a gauze strip under the tubed pedicle by which it was constricted. The dotted line and shaded area on the face show the incisions into which the flap was later implanted after undermining the scar for relaxation. After a blood supply through the upper pedicle was assured, the lower pedicle was cut and the flap transferred to the face *b*. *c*, Is a photograph of the flap in place and also shows the rubber bands so placed as to take the tension off the tubed pedicle.

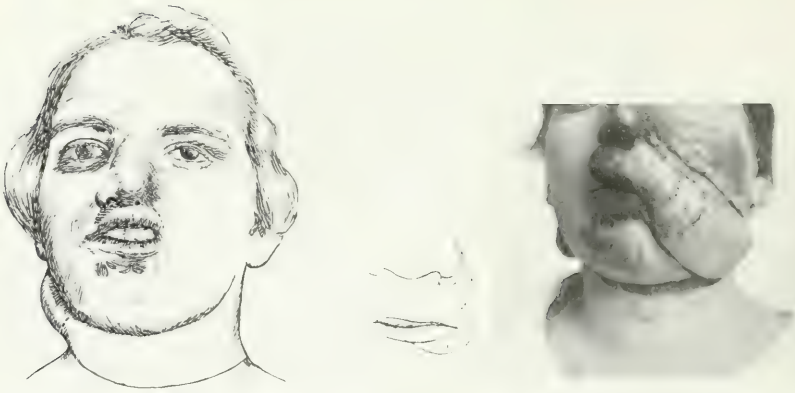

Fig. 13.—Delayed transfer of a submental flap to the upper lip and nose. Stout women are particularly difficult subjects on which to obtain thin, narrow flaps. *a*, Shows a submental flap cut with a double pedicle, one tubed for intermittent compression; *b*, shows the flap transplanted to the upper lip and three flaps outlined on its pedicle: flap *1* was used to line the newly constructed nostril, flap *2* made the ala and covering for the side of the nose, while flap *3* replaced a scar in the lower lip as shown in *c*. Flaps *1* and *2* were raised and sutured back into their beds at a preliminary operation, but flap *3*, on account of the difficulty of previsualizing its exact position, was not raised until *1* and *2* were implanted in their new positions, when *3* was immediately transferred to its new site. Flaps *1* and *2* survived entirely without hesitation but half of flap *3* sloughed.

Fig. 14, *a*.—Repair by multiple flaps with delayed transplantation. Photograph showing the condition immediately after the destruction of a large carcinoma of slight malignancy which had been indolent for 15 years but became active following the use of irritants and radiation. It was removed with the chisel and cautery.

Fig. 14, *b*.—Same patient ready for the finer work about the eye socket for the wearing of an artificial eye, a cartilaginous graft to restore the malar eminence, a Wolfe graft in the forehead, and restoration of the right angle of the mouth.

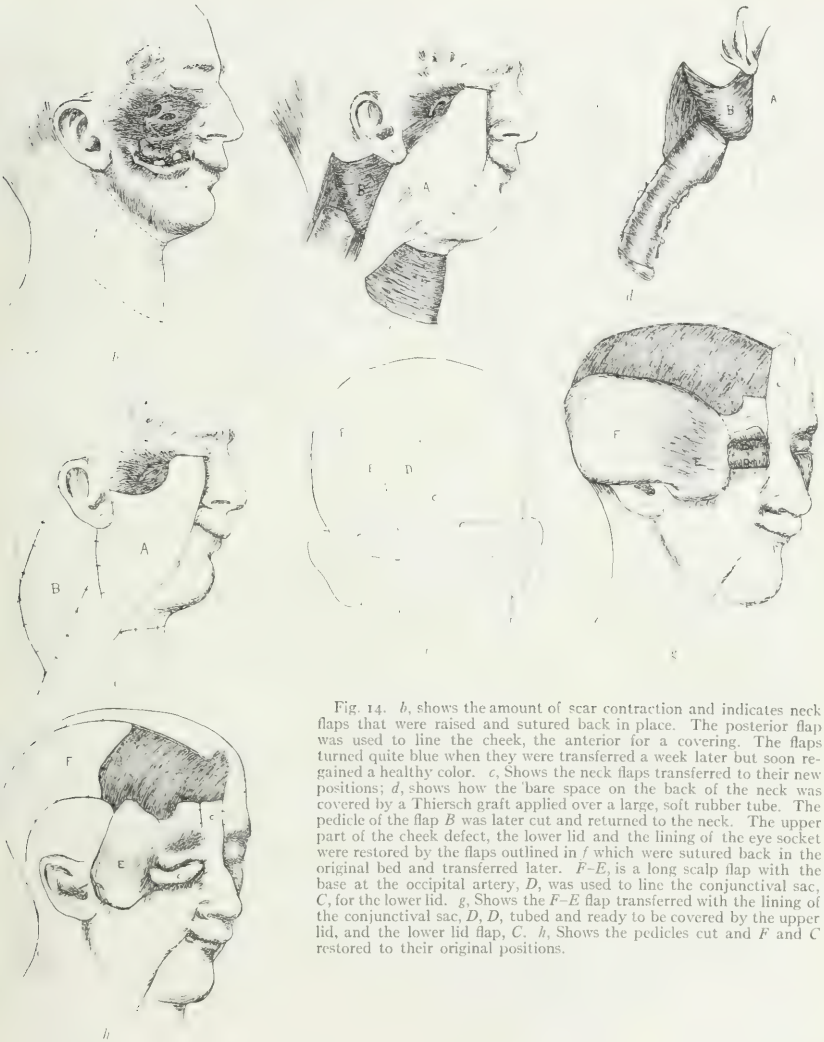


Fig. 14. *b*, shows the amount of scar contraction and indicates neck flaps that were raised and sutured back in place. The posterior flap was used to line the cheek, the anterior for a covering. The flaps turned quite blue when they were transferred a week later but soon regained a healthy color. *c*, Shows the neck flaps transferred to their new positions; *d*, shows how the bare space on the back of the neck was covered by a Thiersch graft applied over a large, soft rubber tube. The pedicle of the flap *B* was later cut and returned to the neck. The upper part of the cheek defect, the lower lid and the lining of the eye socket were restored by the flaps outlined in *f* which were sutured back in the original bed and transferred later. *F–E*, is a long scalp flap with the base at the occipital artery, *D*, was used to line the conjunctival sac, *C*, for the lower lid. *g*, Shows the *F–E* flap transferred with the lining of the conjunctival sac, *D*, *D*, tubed and ready to be covered by the upper lid, and the lower lid flap, *C*. *h*, Shows the pedicles cut and *F* and *C* restored to their original positions.

Fig. 15. Failure to close cheek-orbit defect by immediate transplantation of a forehead and submental flap. Success by a later delayed transplantation. *a*, Shows the condition after removing a carcinoma from the cheek and orbit with cautery and chisel. The nasal septum and ethmoid cells show in the bottom of the wound. This growth had remained small and indolent until irritated into activity by the use of a cancer paste. *b*, Shows the condition after scarring had occurred. The dotted lines illustrate two flaps that were raised to fill the defect, the upper as an outer covering, the lower as a lining. The upper flap has the temporal artery and vein in its pedicle and this is usually considered safe for immediate transfer. The lower flap being brought to a position above its base is less likely to be embarrassed by impeded blood return. Immediate transplantation was done, shown in *c*, but the next day the blueness of the forehead flap strongly suggested the advisability of removing all sutures and restoring it to its original position to save as much of it as possible. The neck flap was tubed and attached to a small flap turned from the chest, shown in *d*. About 2 centimeters of forehead flap was lost by slough. At a later period, repair was made with delayed transplantation of the remaining part of the forehead flap and the tubed neck flap. *e*, Shows the healed condition ready for making a socket to carry an artificial eye.

*a* *b* *c*

Fig. 16. Restoration of an eye socket and eyelids. *a*, shows a soldier in whom a piece of shell passed through the malar bone and outer wall of the orbit, through the orbit into the nose, destroying everything but the outer skin of the upper lid and leaving a large communication between the orbit and the nasal fossa. A posterior wall was given to the conjunctival sac and the communication between the orbit and the nose was closed by a flap taken from the forehead. The upper lid was made to do duty for both lids and a lining for the lids, as well as a flap for the repair of a nasal defect, was obtained from the forehead by delayed transplantation. *b*, Shows the flaps in place, the pedicles not yet cut; *c*, shows the glass eye in place but the nose not finished.

*a* *b* *c* *d*

Fig. 17. Reconstruction of an ear. *a*, Shows what remained of an ear after an automobile accident, also three flaps that were raised and sutured back into their beds to be later draped over a cartilaginous implant from the fifth costal cartilage. The long neck flap sloughed at its tip while in its original bed. *b*, Represents an intermediate stage; *c* and *d*, show the present condition and a year will elapse before final adjustments are made

resistent to infection after a delayed transfer.

13. That certain complicated, time-consuming operations are advantageously divided into two sittings by this procedure.

14. That occasionally after suturing the flap back in its original bed, the transplantation will of necessity be long delayed by a low grade suture infection or an infection in the bed. Any of these occurrences is an incident rather than a calamity and is to be guarded against by not drawing the sutures tight, by removing them early, by free drainage and ordinary cleanliness.

15. That when any part of the flap sloughs while in its original bed, that part, no matter how superficial the slough, should not be transplanted (Fig. 5).

16. That another disadvantage of the method, more apparent than real, is it involves two operations in place of one. My own experience has been that two properly planned operations usually bring success while the single operation has too often been followed by immediate failure necessitating a larger number of subsequent steps.

17. That even delayed transfer has not been successful in every case (Fig. 5).

The accompanying pictures were selected to bring out the various points related to the phase of the subject under consideration.

# FRACTURES OF TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRÆ

By GEORGE G. DAVIS, M.D., F.A.C.S., Chicago

FRACTURES of the transverse processes of the lumbar vertebræ are not infrequent injuries but have been frequently overlooked. With modern improvement of our X-ray technique, aided by the use of duplitized films, intensifying screens, and especially the Potter-Bucky diaphragm, many cases formerly diagnosed "sprained back," "malingering," etc. are now found to be fractures of the transverse processes.

In reviewing the literature on this subject there seems to be considerable difference of opinion as to the factor in causing the fracture. Some observers (Hartwell, 1; Roberts and Kelly, 2; and others) state that the process fractures result almost invariably from direct trauma. DeQuervain (3), Traves (4), and others say that the injury may result from direct or indirect violence. Stimson (5) states that fractures of the transverse processes occur in combination with other fractures, but are rare except in such cases and that in the few instances in which fracture has occurred alone it is the result of gunshot injury. Rhys (6) states that these fractures are developmental in origin adding that fractures occur in the absence of injury in almost all the cases and that the first lumbar is the most frequently affected.

A review of the embryology of the transverse processes in the lumbar region and a study of the transverse processes, with relation to their muscular attachments, seem to clear up several points in etiology.

## EMBRYOLOGY

The cartilaginous vertebra is ossified from three primary centers, two for the vertebral arch and one for the body (Fig. 1). The ossific granules appear first in the situations where the transverse processes afterward project, and spread backward to the spinous process, forward into the pedicles, and lateralward into the transverse process. At birth the vertebra consists of three pieces: the body and the halves of the vertebral arch. Before puberty no further changes occur except a gradual increase of these primary centers, the ends of the transverse processes being cartilaginous. About the sixteenth year, two secondary centers appear, one for each transverse process. These secondary centers fuse with the transverse process about the age of 25 (Fig. 2). From this secondary

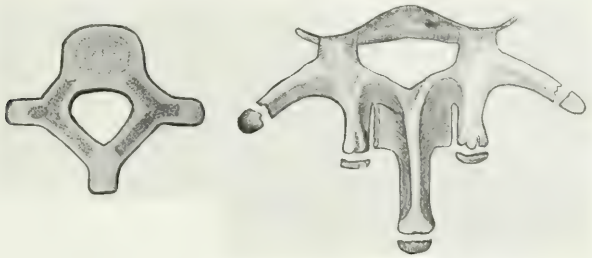

Fig. 1 (at left). Showing the three primary centers of ossification of the vertebra: two for the vertebral arch and one for the body. (Gray's *Anatomy*.)

Fig. 2. Showing secondary centers of ossification for transverse processes which appear at about the sixteenth year and which fuse with the primary centers normally at the twenty-fifth year. (Gray's *Anatomy*.)

center the transverse process of the first lumbar is sometimes developed as a separate piece, which may remain permanently ununited with the rest of the bone, thus forming a lumbar rib (Fig. 5, Case 2).

ANATOMY

The muscle in which we are most interested in considering transverse process fractures in the lumbar region is the quadratus lumborum (Fig. 3). It is irregularly quadrilateral in shape and broader below than above. It arises by aponeurotic fibers from the iliolumbar ligament and the adjacent portion of the iliac crest for about 5 centimeters, and is inserted into the lower border of the last rib for about half its length, and by small tendons into the apices of the transverse processes of the lumbar vertebræ.

The action of the quadratus lumborum muscle is to draw down the last rib and it acts as a muscle of inspiration by helping to fix the origin of the diaphragm. If the thorax and vertebral column are fixed, it may act upon the pelvis, raising it toward its own side when only one muscle is put in action, and when both muscles act together either from below or above they flex the trunk.

Now if the thorax, spine, and pelvis are all three fixed and a force is applied to the muscle, it is evident that something must give, and a fracture of the transverse process, a separation of a lumbar rib, or a separation of the twelfth rib, or a combination of these, results.

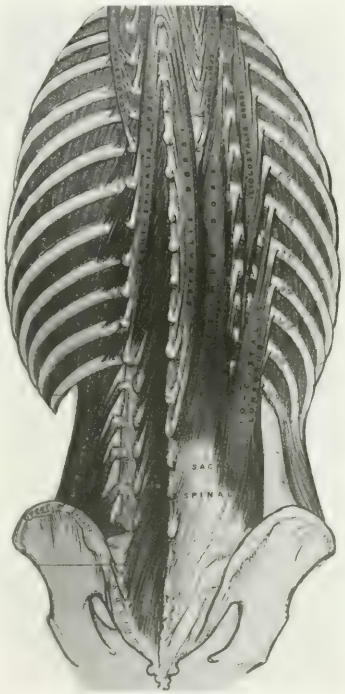

Fig. 3. Showing the quadratus lumborum with its origin from the pelvis and insertion into the tips of the transverse processes and into the last rib. (Gray's *Anatomy*.)

Fig. 4. Case 1, showing fracture of the first, second, third, fourth, and fifth lumbar transverse processes on the right side with marked diastasis and fracture of the first on the left side. Age 33. Cause: severe contusion.

That is by indirect violence. And it is the writer's opinion that practically all of these fractures occur in this manner.

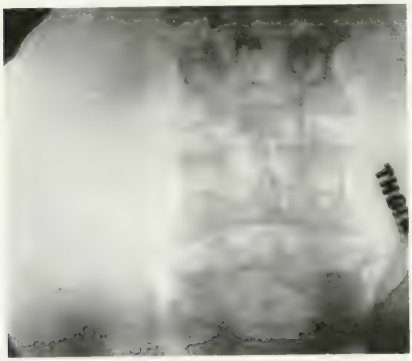

Fig. 6. Case 3, showing fracture of the second, third, fourth, and fifth lumbar transverse processes on the right side and osteo-arthritis (lipping) of the third and fourth lumbar vertebræ. Age 52. Cause: contusion.

Fig. 5. Case 2, showing fracture of the transverse processes of the first, second, third, fourth, and fifth lumbar vertebræ on the right side. The first lumbar process has taken on the form of a lumbar rib and is dislocated from its normal position. Age 40. Cause: contusion.

Fig. 7. Case 4, showing fracture of the left transverse process of the fourth lumbar vertebra and osteo-arthritis (lipping) of the second, third, and fourth lumbar vertebræ and a fracture of the lipping of the upper left border of the body of the fourth lumbar vertebra. Age 46. Cause: severe contusion.

Fig. 8. Case 5, showing fracture of the right fourth lumbar transverse process with but slight diastasis. Age 34. Cause: contusion of back.

Fig. 9. Case 6, showing linear fracture of the left second and third lumbar transverse processes. Age 41. Cause: a severe squeeze of the back.

If the patient is under 25 years of age, it is possible that the secondary ossific centers present a *locus minoris resistentiæ* at their union with the primary ossific centers of the transverse process. However, the 10 cases that are reported in this paper are respectively 33, 40, 52, 46, 54, 41, 23, 48, 30, and 39 years old; the youngest 23, the oldest 54, and averaging 40 years plus. Evidently in these cases it was not a question of separation of ossific centers.

In two of these 10 cases, 1 and 8, there were bilateral fractures of the transverse processes; in Case 1 on the right side all five processes and on the left the first were fractured. In

Fig. 10. Case 7, showing fracture of the transverse processes of the right side of the third and fourth lumbar vertebræ. Age 23. Cause: contusion of back.

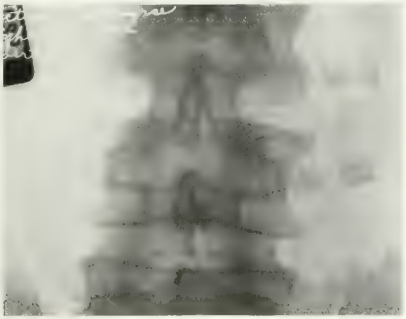

Fig. 11. Case 8, showing fracture of the transverse processes of the lumbar vertebræ, right side third and fourth and left side fourth; associated osteo-arthritis, lipping, of the third and fourth lumbar vertebræ with fracture of the tip of body of the fourth vertebra, left upper border. Age 48. Cause: contusion of back.

Fig. 12. Case 9 showing fracture of the left transverse process of the second lumbar vertebra. Age 39. Cause: injured by a fall of slate in a mine.

Fig. 13. Case 10, showing fracture of the right transverse processes of the first, second, and third lumbar vertebræ and dislocation of the right twelfth rib, and compression fracture of the first lumbar vertebra. Age 39. Cause: patient was "buckled" in a coal slide in mine.

Case 8 on the right side the third and fourth and on the left the fourth processes were fractured. And in both of these cases there was no injury to the spinous processes. Both cases were the result of heavy weights injuring the lumbar region. Thus it is not conceivable that a force could strike the transverse processes on one side and fracture them and then shift the weight to the opposite side and fracture the others without involving the intervening spinous processes. The answer is that the force was placed upon the quadratus lumborum and fracture resulted from muscular pull, or indirect violence.

The symptomatology of these injuries is definite. Pain in the back, "backache," is the chief symptom. The pain is well localized, constant, and does not radiate. It is exaggerated by any motion that changes the line of the weight of the body. Rising from the incumbent to the sitting position and from the sitting to the erect position increases the pain. In no position other than lying relaxed in bed is the patient free from pain. Flexion and hyperextension of the spine, and lateral bending, both toward and from the injured side, cause pain. Bending toward the injured side sometimes causes more pain than bending from the injured side. Muscular rigidity and a point of exquisite tenderness over the fractured processes are noted. This pain in the back is not accompanied by any neurological symptoms. In some cases, however, these symptoms, though present, are of such a slight degree that the patient goes back to his occupation in a few weeks having but slight complaint. This, however, is not the rule.

X-ray examination of these cases may show a linear fracture with the fragment in good position. More often, however, there is considerable diastasis of the fragments. If there is a lumbar rib (Fig. 5, Case 2) this may be seen dislocated from its articulation with the spine or the same may be true of the twelfth rib (Fig. 13, Case 10). In the writer's cases osteo-arthritis of the body of the vertebra was associated with fractures of the process in three of the patients (Figs. 6, 7, and 11).

The diagnosis is made by the history of a fall or injury to the back resulting in an area of localized tenderness, lateral to the median line of the spine. As is the case in diagnosis of fractures of long bones this localized tenderness is the most reliable sign. X-ray, of course, will show the fractures. Many cases which would not be recognized by the

X-ray have doubtlessly been overlooked and considered only as sprains.

CONCLUSIONS

Indirect violence plays the most important rôle in these fractures.

The occurrence is noted in patients of advanced years, men beyond the age in which we would expect separation of the secondary ossific centers from the primary ossific centers of the transverse processes.

The condition is often associated with osteoarthritis.

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# CAVERNOUS HÆMANGIOMA OF LEFT LOBE OF LIVER

## Weight Three Pounds Fourteen Ounces; Extirpation of Left Lobe of Liver; Recovery[1]

By CHARLES H. PECK, M.D., F.A.C.S., New York
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CAVERNOUS hæmangioma of the liver is a relatively rare condition, though a review of the literature shows a number of examples, both autopsy and operative reports. The following case seems of sufficient interest to be worthy of record.

Mrs. G. W., age 34; born in Russia; married; one child; came to this country at the age of 21. No previous history of any moment. For about one year prior to operation she had not felt well, had vague discomfort in abdomen with occasional pain, and noticed gradual enlargement of abdomen; was troubled with gas and indigestion; bowels became constipated; and lost about 22 pounds in weight. Symptoms have become more marked for the past 3 or 4 months. Physical examination first made by her physician, Dr. J. W. Weinstein, 4 months ago, showed a large, soft, movable tumor in the epigastrium, extending from the ensiform cartilage to the umbilicus; smooth surfaced, elastic, insensitive. Blood pressure, urine, and gastric contents were all practically normal. X-ray showed the stomach displaced markedly to the left, in a vertical position, its lesser curvature lying against the left border of the tumor. The mass was diagnosed as pancreatic cyst. It enlarged slowly while under the observation of her physician, but did not change in position or consistence. Examination, October 20, 1920, was practically as noted, and the diagnosis of the pancreatic cyst was accepted, though there seemed to be rather unusual lateral mobility for such a cyst. Operation was performed on October 22, 1920, at the Roosevelt Hospital. The mass presented was of deep purplish color, smooth surfaced, soft and elastic, free from adhesions. Above, it had a flat, broad pedicle, which, on examination, proved to be the stretched-out coronary ligament of the left lobe of the liver. Below, across its rounded margin, ran a remnant of the sharp edge of the left lobe. The right lobe of liver, gall-bladder, and ducts were quite normal. Examination of the other abdominal organs, pancreas, spleen, kidneys, stomach and intestinal tract, and pelvic organs was negative. Its attachment with the right lobe had been thinned, as had its whole pedicle, undoubtedly by the drag caused by its weight. It was at once evident that it was a lesion of the liver itself and not of the pancreas. It was thought to be probably some form of cyst and total excision was decided upon and performed without great difficulty. The vessels in the pedicle were secured by clamp and ligature, as it was divided step by step, and the mass was removed. The cut edges of the coronary ligaments on the under surface of the diaphragm were sutured with continuous catgut covering the wound surface between and completing hæmostasis. It weighed 3 pounds 14 ounces (1,759 grams) and included the entire left lobe. It was not sectioned at once, as we wished to obtain measurements, weight, and photographs. A day or two later when cut it proved to be a solid mass and not a cyst. Microscopic sections showed this to be a typical cavernous hæmangioma with much destruction of liver tissue and its replacement by the branching blood spaces and fibrous tissue.

The patient made a good recovery and the wound healed kindly by primary union. Convalescence was interrupted by symptoms of a pulmonary infarct on November 12, 1920. There was sharp pain in the left thorax, cough, blood-tinged expectoration, and a rise of temperature. These symptoms continued 3 or 4 days, abating slowly, when another similar attack occurred. This was repeated in all three times.

[1] Read before the Southern Surgical Association, Hot Springs, Virginia, December 14-16, 1920.

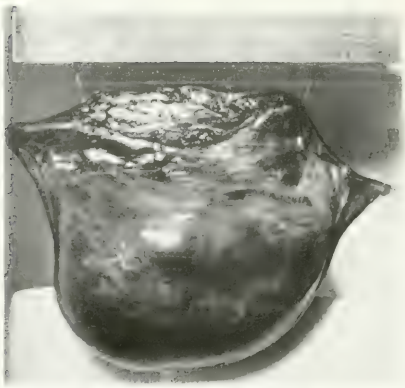

Fig. 1. Photograph, showing anterior surface of tumor, remnant of sharp edge of left lobe, and denuded area which lay between folds of coronary ligament at upper margin.

X-ray of the chest failed to visualize any infarct or area of consolidation. There was also noted, about November 9, 1920, a slight phlebitis of the right leg and calf. This was quite mild in type and subsided in a few days time. The patient was discharged from the hospital on the thirty-second day after operation and is now quite well.

*Pathological report.* Specimen: Entire left lobe of liver.

Fig. 2. Photograph of tumor cut and laid open.

*Microscopic examination.* Specimen consists of a large rounded cystic feeling mass, of color of liver tissue, measuring 26 by 20 by 9 centimeters and weighing 3 pounds 14 ounces. It is covered by peritoneum which is smooth and glistening, with the exception of one portion, oval in shape, measuring about 14 by 7 centimeters, where mass was dissected from diaphragm. Quite numerous, moderate-sized veins can be seen running under the capsule. The entire mass is soft and apparently contains fluid. At one border is a small tag of normal appearing liver tissue, which is firm, and on section has structure of liver. After hardening for several days, the mass was sectioned. Cut section shows a red, homogeneous surface, apparently very hæmorrhagic, in which

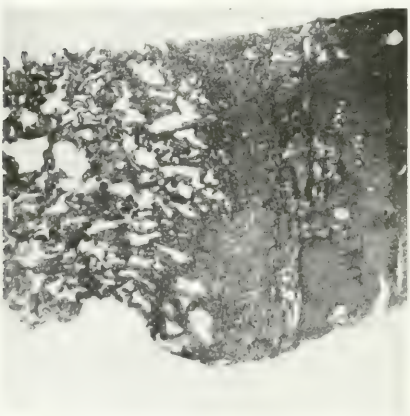

Fig. 3. Microphotograph, low power, showing tissue of hæmangioma to the left, and liver tissue comparatively unchanged to the right.

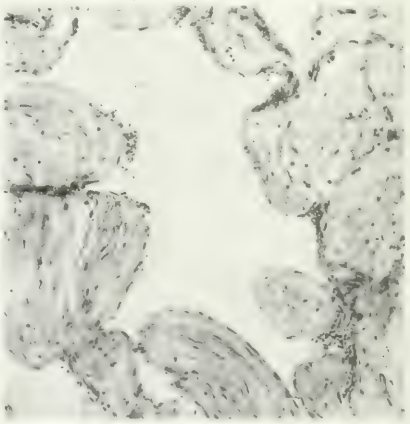

Fig. 4. Microphotograph, high power, showing structure of fibrous septa and endothelial lining of large cavernous spaces.

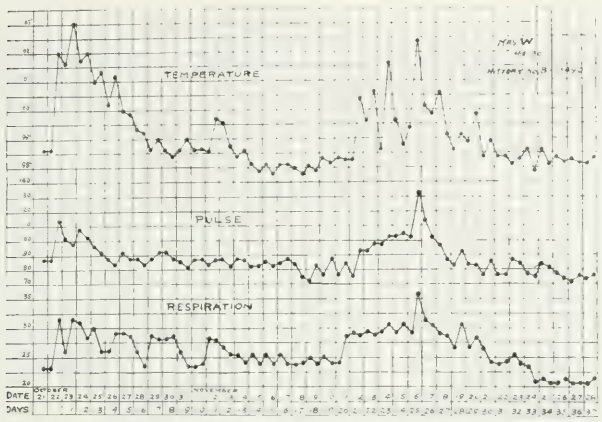


Fig. 5. Temperature chart. Moderate operative reaction. Recrudescence of fever corresponding to pulmonary infarcts during convalescence.

white, irregular islands and strands of tissue can be seen in large number. These are firm, while rest of tissue is soft and very bloody. After several more days in formalin, much of semi-fluid content of mass is drained out and the cut surface has a definite spongy appearance, from which fluid can be squeezed and which will again take up fluid.

Section I shows portion of large fibrous bundle to be made up of fibrous connective tissue. From this septa pass out in various directions. Between these septa are masses of red blood cells.

The septa are composed of connective tissue and the surfaces are lined with a layer of flattened cells, resembling endothelium. The section of liver tissue looks normal.

*Diagnosis:* Cavernous hamangioma of left lobe of liver.

This report was made by Dr. William C. White, surgical pathologist to the Roosevelt Hospital, and confirmed by the Department of Surgical Pathology at the College of Physicians and Surgeons, Columbia University.

McCallum (1) cites briefly a large pedunculated angioma, 24 centimeters in diameter, hung by a stalk from the right lobe of the liver, weight not given. Major and Black (2) report the largest tumor on record, 18,160 grams (37 pounds), 49 per cent of the total body weight, at the time of death.

The tendency of these tumors seems to be to attain large size before proving fatal.

Fig. 6. Photograph of patient taken November 28, 1920. 37 days after operation. A mass weighing 3 pounds, 14 ounces, and including the entire left lobe of the liver, was removed.

Mantle (3) performed exploratory laparotomy for a huge hæmangioma of the right lobe, 12 inches by 6.5 inches in diameter. The patient died within 2 hours from hæmorrhage following needle puncture of the tumor and subsequent ineffectual attempts to control the bleeding by sutures and packing.

Chiara (4) reports a case operated on by Freund of rupture of an enormous angioma of the left lobe during exploratory laparotomy with death from hæmorrhage within an hour. We have been able to collect records of 21 operative cases, in 17 of which the tumor was excised with 15 recoveries and 2 deaths. Of the whole number, 15 were females and 6 males. The left lobe was most frequently affected, the tumor being situated in the left lobe in 11 cases, the right lobe in 7, Spigelian 1, multiple tumors 1, site not stated, 1. The largest case excised was that of Pfannenstiel (5), reported also by Langer (5), in which the collapsed growth weighed 5 pounds and the estimated weight, before the blood escaped, was 10 pounds. The patient made a good recovery ultimately, though the operative hæmorrhage was great.

Keen (6) reports an interesting case, in which he formed an artificial pedicle by incising the liver on either side of the growth, then applying an elastic ligature and packing the wound open. The means of controlling hæmorrhage, reported by various operators, have been the elastic ligature, chain ligatures through pedicles, and use of the cautery and packing. In some of the cases, as in my own, the tendency to pedunculation of the tumor facilitated its removal, without great loss of blood. This tendency is evidently due to the weight of the tumor exerting a constant drag on the soft liver tissue and weak ligaments. On the other hand, excision of cases with broad attachments to the liver has been difficult and accompanied by serious hæmorrhage. Incision into, or even needle puncture of the tumor, has proved exceedingly dangerous and even fatal in some of the reported cases. I believe our own case to be the largest tumor successfully excised in this country, and the second largest successful excision reported, the largest being the case of Pfannenstiel.

No attempt has been made to review completely reports of non-operative cases.

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# LINITIS PLASTICA[1]

By E. PAYNE PALMER, M.D., F.A.C.S.; W. WARNER WATKINS, M.D.; and HARLAN P. MILLS, M.D., Phoenix, Arizona

THIS disease has been given a different name by almost every writer on the subject. The following are some of them: linitis plastica hypertrophica; stenotic hypertrophic gastritis; cirrhosis of the stomach; Brinton's disease; cryptogenetic granulomatosis of the stomach; leather bottle stomach; fibroid induration of the stomach; gastric sclerosis; endogastritis obliterans; *Zuckergussmagen; Magenschrumpfung.*

Linitis plastica was first studied by Andral, and named linitis plastica hypertrophica by Brinton in 1854. It is a disease entity, affecting the stomach and, very rarely, the small and large intestines, spreading to the adjacent structures by continuity.

In this paper we will deal with the affection of the stomach only. Linitis plastica is a disease of the stomach, producing diffuse and marked hypertrophy of the submucous connective tissue, and, to a lesser degree, of all of the coats except the mucosa, where there is an atrophy of the glandular elements. The stomach walls are markedly thickened, usually from six to eight times the normal thickness, and are rigid and hard like a leather bag, with a diminution of the lumen. The wall at the pylorus is much thicker, harder and more glistening than that toward the cardia. The chief characteristics of the affection are a slow, progressive stenosis of the stomach, resulting in food stagnation, and often a perceptible tumor in the epigastric region, with an absence of pain, hæmorrhage and early vomiting.

There are two forms of the disease: the localized and the diffuse. The localized is usually situated at or near the pylorus; the diffuse commences at or near the pylorus and extends toward the cardia and may involve all of the stomach. The disease does not extend into the duodenum, and here the contrast is very noticeable and of great diagnostic value. When the abdomen is opened, a characteristic picture is seen; the stomach is cylindrical in shape, the surface is smooth, with a dull, pearly white peritoneum. The interlacing strands of fibrous tissue are plainly seen beneath the peritoneum. Palpation shows the stomach to be hard, rigid, and thick, resembling the feeling of cartilage or contracted muscle.

The disease is classified as both benign and malignant. Morison states that over 50 per cent of the cases are carcinomatous. Lyle has collected reports of seventy benign and sixty malignant cases.

The disease is found in adults only; the greatest number of cases occurring between the ages of 40 and 60 years, and about twice as often in men as in women.

## HISTOPATHOLOGY

The essential histological change would appear to be a sclerosing process, due to the formation of new fibrous tissue, chiefly in the submucous and subserous layers, but also infiltrating to a lesser degree the muscularis. The question of malignancy has been extensively discussed, some writers considering the condition benign, others finding a large percentage malignant, while Ewing concludes that all cases are primarily carcinomatous, but because of the sclerosing process the last traces of atypical epithelial structures disappear in a small percentage of cases. Though it is possible that such a process may result from purely inflammatory sclerosis, the probability is that the great majority, if not all, cases, are atypical sclerosing fibrocarcinomata. The condition apparently originates at or near the pylorus and spreads by continuity along the coats of the stomach and in a few instances also involves the duodenum and adjacent tissues, although lymph-node or distant metastases seldom occur.

## SYMPTOMATOLOGY

The onset is gradual, with loss of appetite, disturbed digestion, eructation of gas, and the patients find that they must discontinue the heavier articles of diet, or they are retained

[1] Presented at the Arizona section of the Clinical Congress of American College of Surgeons, Phoenix, Arizona, November 16, 1925.

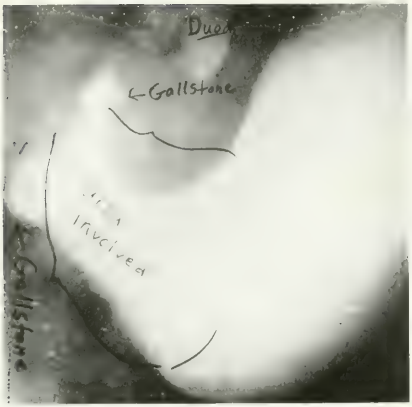


Fig. 1.—Roentgenogram of stomach showing area of involvement in linitis plastica.

in the stomach and vomited. The vomiting is usually voluntary, to relieve distress. There is loss of weight and cachexia. The symptoms gradually increase in severity, so that only light liquids can be taken; finally complete stenosis results, producing death by starvation. In some cases, the obstructive symptoms appear rapidly. Examination discloses a mass in the epigastrium, which is usually freely movable except late in the disease. The mass is extremely hard, and transmits the pulsation of the abdominal aorta plainly to the palpating hand.

### DIFFERENTIAL DIAGNOSIS

Linitis plastica resembles scirrhous carcinoma and cirrhotic syphilis of the stomach, and has frequently been mistaken for the former, both before and after the abdomen is opened. The large tumor gives a very unfavorable appearance, and if unrecognized, and considered to be inoperable carcinoma, the abdomen is closed or a gastro-enterostomy is done.

Linitis plastica gives a history of disturbed digestion, with a gradual decrease in the capacity of the stomach, voluntary vomiting to relieve distress, an absence of pain, and a negative Wassermann; a mass in the epigastric region can be felt, which, if the disease is advanced, is excessive in proportion to the subjective symptoms.

In carcinoma, pain is present in 90 per cent of the cases and usually occurs early. Vomiting occurs as a marked symptom in 73 per cent of the cases, and is usually involuntary, hæmatemesis or melæna occurring in 35 to 40 per cent of the cases.

Syphilis of the stomach is seen in younger patients, usually under 40 years of age. Pain caused by the taking of food is delayed in the earlier stage of the disease, and is quite prompt after meals in the later course. The pain is associated with nausea and vomiting. There is an absence of hæmorrhage and maintenance of a good appetite in the majority of cases of stomach syphilis. A positive Wassermann can usually be obtained in the acquired type and a careful history and physical examination would show other abnormalities in the congenital type.

The laboratory findings are usually not characteristic.

*Capacity examination* shows a diminution and the stomach cannot be distended. Test meal will show a diminution in acidity, with little or no free hydrochloric acid. The stomach frequently contains pus, and blood may be found in the stomach contents or in the stools because of the ulceration present in the majority of the cases.

*Blood examination* will show a secondary anæmia.

*The roentgen examination* offers the best means of recognizing the lesion, although the resemblance to scirrhous cancer and syphilis persists in the X-ray appearances. So long as scirrhous carcinoma and linitis plastica are used as interchangeable terms for the same lesion, a close differentiation between the two is unimportant. The X-ray differentiation of stomach syphilis is more important, but not always possible.

As stated by Carman, the roentgen-ray characteristics of linitis plastica are those of a filling defect with a relatively smooth inner margin, and with peristalsis absent from the area involved. The pylorus may be either gaping or obstructed.

When the involvement is extensive, the absence of expansibility, as seen on the fluo-

Fig. 2. Roentgenogram of gall-bladder after removal, showing the two large stones.

roscopic screen, is very striking, the stomach being small, contracted, and drawn upward.

When the involvement begins at the pylorus, early obstruction may result, in which case the stomach will appear dilated. This latter type may resemble the pyloric induration of deep ulcer, which sometimes produces obstruction. This resemblance can be all the more striking, since the indurated area of linitis is frequently ulcerated, and it is impossible to determine, except by careful microscopic examination, just what the essential tissue change is.

### TREATMENT

The disease is amenable to surgical procedures only.

Gastrectomy is the operation of choice. If the patient is feeble, the two-stage operation is advisable, that is, a preliminary gastroenterostomy, and a secondary gastrectomy.

The anterior Polya is the procedure of choice, if the patient's condition will permit of a single operation. This operation can be done more rapidly, and is easier for the operator.

The mortality rate is about the same as in various other gastrectomies and there is less postoperative disturbance and greater comfort after this procedure.

If a total gastrectomy is performed, œsophagojejunal anastomosis should be done. Satisfactory results have followed this procedure.

On October 29, 1920, Mrs. L. C., married, age 65, consulted her physician because of a distress in the stomach, extending over a period of 5 to 8 years. The onset was very insidious but distress has been becoming progressively worse. First attacks frequently awakened her at night, and distress would wear off in a few hours after taking a solution of

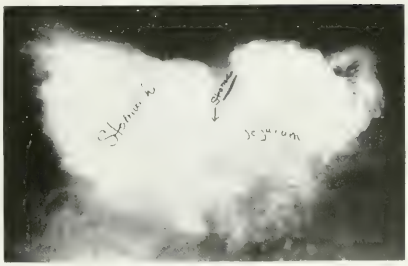

Fig. 3. Roentgenogram of stomach 2 weeks after operation.

soda bicarbonate. During the early period, the attacks occurred at intervals of many months; in the last year the attacks have become more frequent, especially during the 3 preceding months. The location of the distress was in the epigastrium, extending laterally to the upper right and left quadrants.

*Family history.* One niece died of tuberculosis; one sister had been operated upon for carcinoma of the uterus 7 or 8 years ago; otherwise negative.

The patient had measles and whooping cough during childhood. The periods were always regular, of the three-day type; moderate amount; no pain or discomfort. She had had two children, normal birth, accompanied by little laceration; menstruated twice after birth of last child; menopause 20 years ago.

The present trouble began about one week ago, with aching over the upper abdomen, extending laterally, voluntary vomiting, giving slight relief. The vomitus was very sour but contained no blood. The stools were not tar colored. Eructation of gas always followed taking of food. Patient avoided heavy articles of food in the hope of obtaining some relief from distress, and has limited her nourishment to light broth, finding that this is the only nourishment that she can take with any degree of comfort. Weight was normal until the past week, when she lost 10 pounds. Complains of weakness, which she attributes to lack of nourishment. She has never been confined to bed during the present or previous attacks.

*Examination.* Patient was well nourished. Careful physical examination disclosed no abnormality except a large, hard, movable tumor in the epigastric region, which transmitted pulsation of the abdominal aorta to the palpating hand. Examination of urine showed it to be normal.

*Blood.* Red cells, 4,360,000; white cells, 10,600. Hæmoglobin, 40 per cent; lymphocytes, 35 per cent; polymorphonuclears, 65 per cent.

*X-ray examination.* Stomach is narrowed and the wall is stiffened in the pyloric portion and shows no peristaltic action. This is the picture of carcinoma, and from the X-ray examination, conclusion would be that the whole pyloric third of the stom-

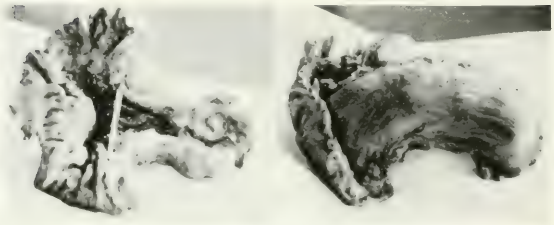

Fig. 4. Interior view of resected portion of stomach.
Fig. 5. Exterior view of resected portion of stomach.

ach is involved. So far as the stomach proper is concerned, this would be in the operable stage. Stomach was empty at 6 hours. Rounded protuberance from the pylorus not diagnosed at X-ray examination. (Note: This was shown by operation to be a gall-stone.) Diagnosis: Advanced carcinoma of stomach, probably operable.

*Operation, November 1.* A right paramedian incision was made. Exploration showed the tumor to involve pyloric and middle third of stomach. The stomach was cylindrical, with hard, thickened walls, free from adhesions and nodules. The surface was smooth, with a dull, pearl white peritoneum. The interlacing bands of fibrous tissue could be plainly seen and felt beneath the peritoneum. The thickening stopped abruptly at the pylorus. The contrast between the pylorus and the duodenum was pathognomonic of the disease. No enlarged glands were found. There was a hydrops of the gall-bladder, the bladder being unusually large, and contained two large stones. Otherwise no abnormality was found. The anterior Polya gastrectomy was performed. All of the diseased tissue was removed. Cholecystectomy was also performed.

The patient has made a most satisfactory convalescence. She was out of bed on the ninth day after the operation, and is now taking a general diet with no discomfort.

*Pathology.* Specimen consists of pyloric and middle portion of stomach and measures 18 centimeters along greater curvature and 9 centimeters along lesser curvature. On section, the stomach wall shows very marked thickening and induration and marked reduction of the lumen. The mucosa is thrown into excessive folds, but otherwise no marked thickening of mucosa is noted. The abnormal change is shown chiefly in the submucosa, muscularis, and subserous coats. The muscularis is seen in gross specimen to be greatly increased in depth and feels tough, elastic, and leathery. This condition of the stomach wall ends rather abruptly about 4 centimeters within the line of incision and the induration does not extend into the duodenum.

Near the pylorus is an ulcer with precipitous edges.

Microscopic sections of this area show the ulcer extending to beneath the mucosa, the floor being covered by a narrow zone of necrosis.

The mucosa adjacent to the ulcer shows an excessive amount of new formed fibrous tissue, abnormally separating the gland tubules. The submucosa is greatly thickened and fibrous. The same is true of the subserous layer. The muscular layer is also slightly thickened, due to interposed bands of dense fibrous tissue. Scattered irregularly through this fibrous tissue, from the serous border to well within the deeper portions of the gland tubules of the mucosa, are seen larger atypical cells, with deeply staining nuclei. These cells are widely separated, except that occasionally in the subserous area fairly characteristic alveoli are formed.

Sections from area farther removed from the pylorus show a similar arrangement, except that there is much less dense fibrous structure and the atypical cells are found invading to a greater extent the glandular tubules of the mucosa. In limited areas where erosion of the mucosa is present, these cells are found at the very margin. Sections from the margin farthest from the pylorus do not show carcinomatous involvement nor definite increase in fibrous structure.

*X-ray post-operative findings.* Barium meal fills the cardiac end of the stomach, which lies entirely to the left of the median line, with abrupt termination at stoma, the meal reappearing in the small bowel just beyond, this shadow having the typical feathery appearance of jejunum. Gastrojejunostomy with normal stoma.

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# INTERSTITIAL TUBAL PREGNANCY[1]

## A Report of Two Cases

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JUDGING from various statistics the occurrence of interstitial ectopic gestation is infrequent enough to warrant reporting.

The following cases are from the gynecological service of Dr. Irving S. Haynes at the Harlem Hospital.

Case 1. H. R., age 29, married, para-II; nativity—Russia; color, white; was admitted July 20, 1920, with the following history: In July, 1919, the right fallopian tube had been removed for chronic salpingitis. About 6 months prior to admission, she was curetted for a 3 months incomplete abortion. The last regular menstruation was May 27, 1920, sexual intercourse following 10 days later. The present illness began with cramps in lower abdomen 5 hours before admission. She vomited greenish fluid and gradually became weaker and pale. A laparotomy was performed shortly after admittance.

On opening the peritoneum a large amount of blood escaped; the uterus and adnexa were explored; the right tube was not found. The left tube was found normal; however, a moderate number of small follicular cysts were present in both ovaries. The body of the uterus was slightly enlarged and the seat of multiple small fibroids. On the upper aspect of the fundus, about 1 centimeter from the entrance of the fallopian tube I found a rupture which was roughly circular and about ¼ centimeter in diameter, through which blood oozed freely. The left horn with the tube was removed. The embryo was looked for but was not found. The patient was discharged cured on the sixteenth day.

*Pathological report.* Microscopic section through rupture at cornu shows typical chorionic villi. Diagnosis: interstitial ectopic pregnancy.

Case 2. M. B., age 32, married, para-VII; nativity, U. S.; color, white; was admitted October 16, 1920, with following history: No previous operations. All her labors were difficult and in several instances were complicated by fever. The last pregnancy resulted in a 6 weeks' abortion. She was not curetted. Menstrual history—2 weeks overdue. The present illness began about 10.00 o'clock the night before admission with severe cramp-like pains in lower abdomen, more marked in the left lower quadrant and which continued until admission. She vomited several times, did not faint but gradually went into marked shock. A diagnosis of ruptured extra-uterine pregnancy was made by Dr. Brodhead.

On opening the peritoneum dark red blood escaped; the peritoneal cavity was filled with blood and blood clots. The uterus was delivered and found slightly enlarged; the left cornu had a small rupture superiorly, which was roughly circular and about 5 millimeters in diameter, through which

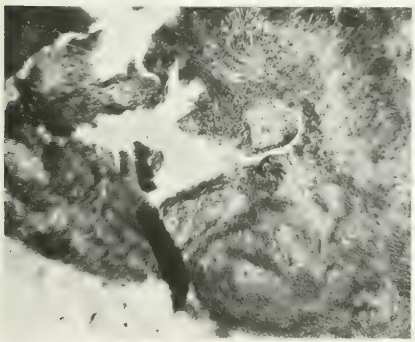

Fig. 1. Section through rupture in Case 1, showing several partly degenerated chorionic villi in partially organized blood clot.

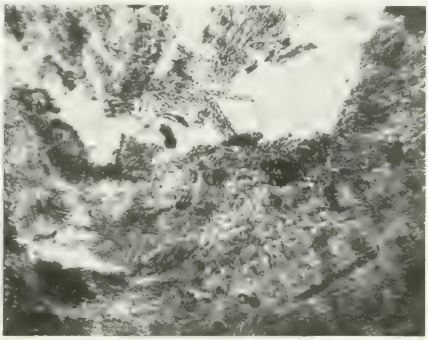

Fig. 2. Section through part of tubal lumen in Case 1, showing destruction of tube villi and lumen filled with débris of degenerated decidual cells and villi.

[1] Presented (by invitation) at the meeting of the Obstetrical and Gynecological Section of the New York Academy of Medicine, November 23, 1920.

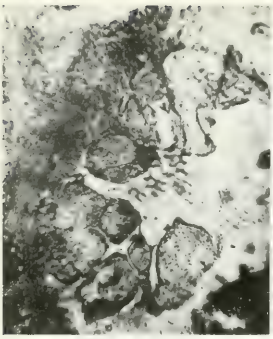

Fig. 3.

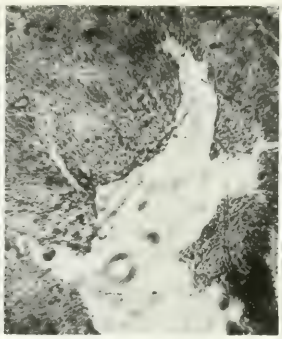

Fig. 4.

Fig. 5.

Fig. 3. Section through rupture in Case 2, showing typical chorionic villi.

Fig. 4. Section through lumen of tube in Case 2, showing decidual reactions in tubal villi.

Fig. 5. Section of tube in Case 2 of isthmial portion just before entering substance of uterus, showing practically a normal tube.

there was moderate bleeding. Both adnexa, with the exception of a follicular cystic right ovary, were normal. The left cornu and adnexa were removed. The embryo was looked for but was not found. The patient died on the eighth day of sepsis (anaerobic hæmolytic streptococcus isolated in blood culture). Postmortem examination revealed no peritonitis, no hæmorrhage.

*Pathological report.* Specimen consists of a fallopian tube about 4 inches long, showing no gross pathological change except at the uterine portion where there is a bulb-like area which, on cross section, shows hæmorrhagic area in wall and lumen.

Sections were taken from the uterine and middle portion of the tube. Microscopic section of enlarged uterine portion of the tube shows a dilated tube with the lumen filled with masses of large decidua like deep staining cells—syncytial cells and typical chorionic villi associated with moderate hæmorrhage. The section apparently bisects several levels of the tube lumen as it traverses the uterine wall and gives the picture of isolated spaces lined by glandular epithelium in the uterine portion of the tube.

Diagnosis: tubal interstitial ectopic gestation.

Microscopic study of the isthmic portion (middle third) of the tube shows a slightly thickened wall with distinctly patent lumen and flattened villi.

Important features connected with the cases just reported are: (1) previous history of abortion, or pregnancy complicated by fever; (2) early rupture; (3) extensive intraperitoneal hæmorrhage; (4) finding of normal adnexa. These features, in my opinion, are important as they tend to explain the course and cause of interstitial ectopic pregnancy.

In reviewing the literature, where a previous history of the patient was given, in most instances a record of previous abortions or uterine infection was obtained. As a similar history was present in the cases just reported —as at the operations—I found the affected and opposite fallopian tubes normal, and as others made the same observations my opinion coincides with that of Farrar in ascribing the cause, except in rare instances, to a previous low grade inflammation of the uterus. This inflammation, while severe enough to affect only a portion of interstitial tube and damaging its lumen to such an extent as to prevent the ovum entering the uterine cavity, yet is not enough to hinder the entrance of the spermatozoa. In cases reported by Farrar, Rose, and others, including those just presented, the rupture occurred very early in pregnancy, about the sixth week. Cases have also been reported where pregnancy went on for a longer period. I believe that the time of rupture and the amount of intraperitoneal hæmorrhage depends on the site of the implantation of the fertilized ovum and the relation of its chorion frondosum to nearby blood vessels. The interstitial portion of the fallopian tube being about 1.5 centimeters long, attachment of the ovum could take place at the uterine end, at the isthmial end, or between these two points, depending on the extent the tubal

lumen had previously been damaged. If implantation should occur near the uterine end, the possibility of an early abortion in the uterine cavity would be apparent; if at the isthmial end, by the trophoblastic action of the chorion frondosum in a place of least resistance, rupture would take place early, generally in the peritoneal cavity, occasionally in the folds of the broad ligament, depending on whether the attachment of the ovum was on the superior or inferior aspect of the tubal lumen. The hæmorrhage resulting from the erosion of arterioles, usually present at this location, would be extensive. If implantation should take place between the uterine and isthmial ends, as the thickness of the musculature of the fundus and of the uterine wall is considerable in this location, it would seem probable that before rupturing, the pregnant sac would attain a larger size, and the uterine rupture would be attended by a very extensive hæmorrhage from marked bleeding from hypertrophied blood vessels, if these be involved.

In concluding I wish to extend my thanks to Dr. Haynes, Dr. Brodhead, and the society for allowing me to present these cases; Dr. E. L'Esperance of Cornell Medical School and the House Staff of the Hospital for their kind assistance.

Fig. 6 (above). Schematic drawing, showing site of rupture in case reported.

Fig. 7. Diagrammatic cross section of tube and uterus, showing possible sites of nidation in interstitial part of tube at *a*, *b*, *c*.

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# LAMINECTOMY FOR MENINGITIS[1]

By ROLAND HILL, M.D., C.M., F.A.C.S., St. Louis

THE advisability of laminectomy with free spinal drainage in certain classes of meningitis is a question that seems worthy of our careful consideration. While no principle in surgery is more deservedly recognized than that of establishing an ample outlet for purulent inflammatory products, still in the cerebral and spinal inflammations we have special and very vital factors to be considered.

The cerebrospinal fluid is a most important secretion that practically forms a water bed for the small brain (1). It is estimated that the normal secretion is replaced every 3 or 4 hours by an entirely new supply and in abnormal conditions, as fracture or lumbar puncture, the alteration in normal tension may result in a very rapid increase in the normal amount of the secretion.

Acute meningitis, especially when of streptococcus or of staphylococcus origin, is a very fatal disease. Netter (2), in a study of 65 cases found that 54 died within 4 days. Death is the result of two factors: increased intracranial tension and toxæmia. The first factor can be influenced by lessening the cerebrospinal fluid by means of lumbar puncture or by the establishment of open drainage. The factor of toxæmia may possibly be influenced by the dilution of the toxins through the rapid secretion of cerebrospinal fluid.

The principle objection to laminectomy along with the operation of cerebral decompression has been made by Dr. Cushing. The objection raised is that purulent products in the base of the skull are sooner or later blocked off, thus rendering a spinal opening useless.

That this objection can not always be sustained is proved by the experimental work of Barr (3). Barr trephined a patient who had died from meningitis and then did a lumbar puncture leaving the cannula in place. The lateral ventricles were then tapped and a solution of methylene blue allowed to flow into them under low pressure. The fluid was observed to escape through the lumbar cannula showing that in this case at least the normal channels of the cerebrospinal fluid were not blocked. Barr repeated the experiment in a case he had operated on as a last resort and although the patient died, he was able to prove conclusively that the normal channels were open.

Dr. Downes reports a case of a boy of 21 who was admitted to the accident ward of the New York Hospital on November 2, 1912, suffering from a linear fracture of the left parietal region, 2½ inches long. Eight days later he developed a marked meningitis with an increased blood pressure, Kernig's sign, and marked leucocytosis. Occipital decompression was done without delay. A bone flap 3½ inches by 2½ inches with its base just above the foramen magnum was made with a Kenyon saw and turned down, exposing the posterior lobes of the cerebrum and cerebellum. The dura over the cerebrum was incised on both sides. There was an escape of ½ ounce of fluid from the left side. Incision was made through the dura of the cerebellum and some fluid escaped. Rubber dam drains were inserted and brought out through drill holes at the angles of the bone flap which was replaced. Within 24 hours the rigidity of the neck had disappeared, blood pressure was 110, and the patient very much better. The drains were removed on the second day and convalescence was uninterrupted. Cultures made from the fluid found in the dura were entirely negative.

Dr. William E. Leighton, of St. Louis (4), has done laminectomy in 4 cases of streptococcus meningitis with recovery in two of them.

It has been my privilege to operate on 2 cases of meningitis with one recovery and one death. Owing to the rarity of successful operations in these conditions, I have deemed my 2 cases worthy of report.

Case 1. My first patient was G. W. H., white, American widower, age 40, a very powerfully built man in the prime of life.

[1] Read before the annual meeting of the Western Surgical Association, Los Angeles, December [illegible], 1913.

On April 28, 1918, while watching a fire in Columbus, Georgia, a cartridge in the burning building was exploded and the bullet struck him just above and to the inner side of the left eye. It ranged backward and inward and lodged in the cribriform plate of the ethmoid. He was not seriously incapacitated at the time and came to St. Louis and presented himself at my office for examination a few days after the injury.

There was an open wound in the upper and inner margin of the left orbit, and a radiographic examination showed that a bullet of thirty-eight caliber had lodged in the cribriform cells of the ethmoid.

On May 6, 1919, I operated to remove the bullet. The patient was given ether and the wound was opened sufficiently to admit the little finger. Some bone spicula were removed but the bullet could not be located until we removed the patient to the X-ray room and worked directly under the fluoroscope. The bullet was then extracted in probably not more than a minute. It was found that the orbital plate was broken and a small piece of bone came away with a little brain tissue. The skin was closed with a running suture of catgut except at the point of insertion of the rubber dam drain. Convalescence was perfectly normal until May 14, when the patient got out of bed although strictly enjoined not to do so.

On May 15, spinal fluid started leaking from the wound. The temperature which had been normal, rose to 101°, pulse 84, respiration 22.

On May 17, the temperature became normal and leakage stopped. The patient complained of a peculiar buzzing in the head.

On May 19, cerebrospinal fluid started to leak from the nose.

On May 21, patient had chilly feelings with rise of temperature to 101°. There was the most intense headache and rigidity in the back of the neck, head being absolutely fixed and thrown back. The meningitis was as marked as I had ever seen it. Kernig's sign was present. The pupils were small and there was active delirium. Blood pressure was markedly increased.

Spinal puncture was done, and the fluid found loaded with pus. The pus showed presence of diplococci and staphylococci.

On May 22 laminectomy was performed under ether anæsthesia. The spinous process and lamina of the third and fourth lumbar vertebræ were removed. The dura was exposed for about 1 inch with an area about ¼ inch wide. This was incised and a large amount of purulent fluid escaped. A section of the dura mater about ¼ inch wide was cut away and a rubber dam drain inserted at the bottom of the wound.

The highest subsequent temperature was 102.8°, pulse 96, respiration 36. Patient was in a stupor and mentally incoherent for 8 days.

On May 30, the rigidity of the neck had disappeared and the drain was removed.

On May 31, temperature was normal for the first time. The headache had disappeared, but he was still somewhat irrational.

By June 6, all the mental symptoms had disappeared and he was perfectly normal.

On June 7 he had a slight chill and a violent headache with a temperature of 101. This, however, proved transient and lasted but a few hours.

On June 20 he was allowed to sit up in the chair. From this time on his improvement was rapid and he left the hospital the last of June. He kept gaining in weight and strength and resumed his regular duties as vice-president and active manager on one of our largest construction companies. He did not suffer any discomfort, pain, or anything to indicate that he had been ill. The spinal incision was perfectly healed and he does not seem to have any tendency to hernia. In November, 1919, without any warning he had what seemed to be an epileptic attack. This disappeared in a few minutes and he has had no further trouble. Up to the time of the epileptic attack he used alcohol quite freely but since then has absolutely abstained. On November 13, 1920, he reports being perfectly well.

Case 2. The second case I wish to report is that of Mr. F. J., white, American, married, age 27, an employe of the Wabash railway.

His case was referred from the services of one of our most efficient nose and throat men, Dr. M. F. Arbuckle. He came into Dr. Arbuckle's hands on September 27, 1919. At that time he complained of pain in the left ear for several days. The first examination disclosed numerous hæmatomata on the drum. The drum was bulging and there was extreme tenderness of the mastoid antrum. Great quantities of pus were coming from the nasal accessory sinuses. The drum was incised on October 9, and there was very free discharge of pus. The local symptoms in the ear and nose then improved very markedly. The tenderness of the bone also disappeared but the patient had an intermittent fever that led to a special examination of the chest and abdomen. Nothing, however, was found. Gradual but slow improvement resulted, and at the end of 2 or 3 weeks the patient was able to come to the office. A discharge from the ear and mouth was still very copious and thick and yellow in character.

On October 23, mastoid tenderness and high fever developed and Dr. Arbuckle was called to the house. He made a diagnosis of meningitis and sent the patient to the hospital on October 24. The temperature on admission was 99.2°, pulse 86. There was tenderness over the mastoid and pain in the back and muscles of the leg. This was associated with marked headache and an elevation of temperature to 102°. The pulse increased to 118. The urinalysis was negative. Unfortunately, no blood count was made. On October 25 spinal puncture disclosed 3 ounces of spinal fluid under pressure.

There was an examination by the National Laboratory which reported that the smear contained no

organisms. There was a high cell count with a polymorphonuclear. Apparently cultures were not made.

On October 25, Dr. Arbuckle did a simple mastoid operation and pus was found present in the mastoid cells. Flexner serum was injected on October 27. Before giving this serum another spinal puncture was done. The fluid drawn from this was cloudy and the cultures made from it were negative.

On October 28 I was called in consultation. The patient was found suffering from a profound meningitis and in a state of moderate stupor, and only semiconscious. He had all the symptoms of meningitis. Temperature was 101.4°, pulse 134.

After consultation we decided that laminectomy offered the best and probably the only possible chance of recovery. Laminectomy was done in the region of the second and third lumbar vertebræ. On opening the dura we were surprised to see only two or three drops of rather turbid fluid escape. An instrument with a blunt point was then inserted upward in the dural cavity. Some dense adhesions were encountered and when these were penetrated we were astonished to see a gush of pure whitish pus that must have been as much as 20 cubic centimeters. Unfortunately, no culture tubes were available so the value of the examination of this fluid was lost. The fact, however, that we had to open through some adhesions before the pus escaped freely shows how readily pus may become walled off in the spinal canal. This would naturally lead to the inference that if operation is to be done it should be done early.

A rubber dam drain was inserted down to the dura and the wound closed. As this operation was done in a small hospital away from the city I did not get an opportunity to see the patient again. The temperature dropped down to less than 100°, and the drainage was very free. The patient, however, was restless and delirious and he died at 7:00 a.m. on morning of the 30th, 2 days after operation.

I believe in cases of meningitis from streptococcus or staphylococcus, operation should be done. Whether or not it will be found advisable in those cases of meningitis following influenza seems an open question.

I have known a few of these cases to be operated upon but have never known one to be operated upon early nor have I known a recovery to follow laminectomy in any of them. Recovery has followed repeated spinal puncture, and it does seem only rational that laminectomy should yield infinitely better results than spinal puncture if done before the cerebrospinal channels are blocked by inflammatory products or adhesions.

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# THE TWO FLAP LOW INCISION CÆSAREAN SECTION

## An Operation Applicable After an Efficient Test of Labor[1]

By ALFRED C. BECK, M.D., Brooklyn

THE maternal mortality following the classical cæsarean section, when it is done late in labor, subsequent to the rupture of the membranes and examination through the vagina, is so high that most operators are unwilling to attempt suprapubic delivery after an efficient test of labor. This fear is justified by the frequent occurrence of peritonitis, which, as many writers have shown, is the usual cause of death in these cases.

Our experience has been fully as unfortunate as that of most obstetricians. In a previous review of the cæsarean sections done at the Long Island College Hospital it was shown that peritonitis caused the death of over 10 per cent of the patients operated upon after a test of labor. In these fatal cases the clinical course following operation was similar to that observed in puerperal infections until the seventh or eighth day, at which time death occurred from peritonitis. The picture was one of an "abdominal calamity" developing suddenly in the course of a puerperal infection. At autopsy we found either a stitch abscess in the uterus or a broken down wound through which contaminated material from the infected uterus escaped into the peritoneal cavity.

This frequency of peritonitis resulting from direct extension through the infected uterine

[1] Read before the Section on Obstetrics of the New York Academy of Medicine, February, 1914.

Fig. 1.

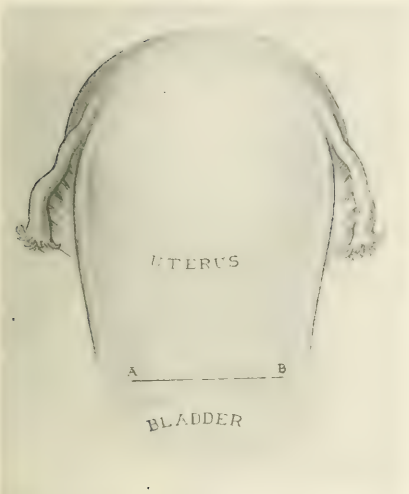



Fig. 2.

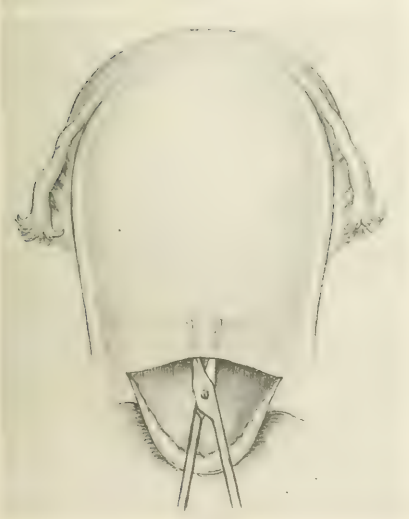


Fig. 3.

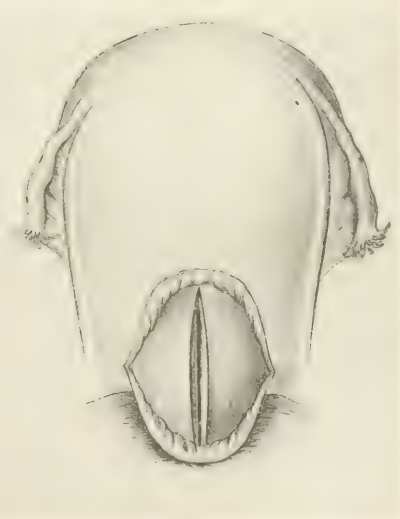


Fig. 4.

Fig. 1. The peritoneum is incised transversely about 2 centimeters above the bladder.
Fig. 2. Showing method of obtaining inferior flap.
Fig. 3. Showing method of obtaining upper flap.
Fig. 4. Incision of uterus after exposing denuded area by retracting the two flaps.

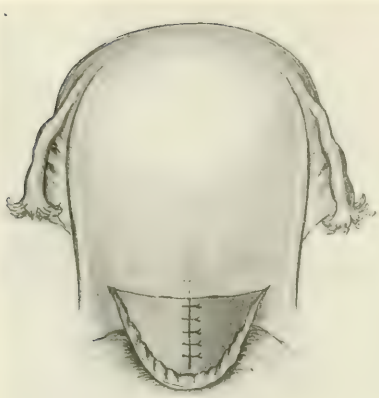


Fig. 5. The upper peritoneal flap is brought down over the superior portion of the closed uterine incision and secured by several interrupted sutures.

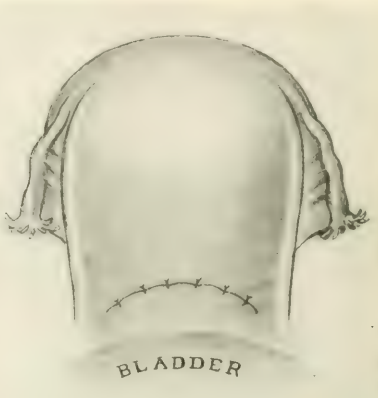



Fig. 6. The remainder of the denuded surface is covered by bringing the lower flap about 1 centimeter above the original incision.

wound, led to the search for a better method of sealing off this area. The operation which I described in the *American Journal of Obstetrics*, February, 1919, apparently gives this desired protection as it has been done 29 times by 4 operators without a fatality.

Before reporting these cases it may be well to review briefly the steps of this technique, which as may be observed is a modification of that described by Kroenig.

### OPERATIVE TECHNIQUE

The uterus is exposed through a transverse or mid-line incision below the umbilicus.

The peritoneum is incised transversely about 2 centimeters above the bladder (Fig 1).

An inferior flap is obtained by stripping the bladder off from the anterior surface of the uterus, as in an abdominal hysterectomy (Fig. 2).

The upper flap is made by gently passing a pair of scissors under the peritoneum (Fig. 3).

The uterus is incised in the mid-line after exposing the denuded area by retracting the two flaps (Fig. 4).

Extraction of the child is accomplished by using one hand as a vectis, and making downward pressure on the fundus. If necessary, forceps may be used to facilitate the delivery.

Before separating and removing the placenta, a catgut traction suture is passed through the lower angle of the uterine wound, as this region of the uterus rapidly sinks into the pelvis. A similar suture is placed in the upper angle. Traction on these two sutures brings the entire wound into view and protects the peritoneal cavity from spill while the placenta and membranes are being removed. (The placenta and membranes may be forced through the cervix into the vagina.)

The incision in the uterus is closed by two series of interrupted sutures. The first passes through the entire wall down to the endometrium, while the second goes through only the outer half of the muscle wall. Each suture, in the latter or superficial series, is placed midway between the deep ones.

The upper peritoneal flap is brought down over the superior portion of the closed uterine incision and secured by several interrupted sutures (Fig. 5).

The remainder of the denuded surface is covered by bringing the lower flap about 1 centimeter above the original incision (Fig. 6).

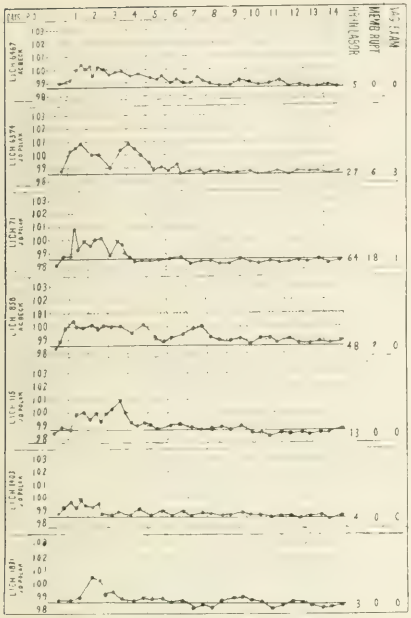


Chart 1.

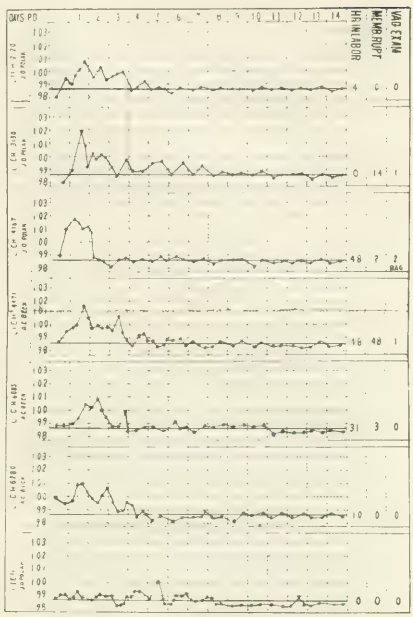


Chart 2.

In this manner the peritoneal flaps are lapped and thoroughly seal the wound in the uterus.

By placing the incision in the lower segment and doubly sealing it with peritoneum, this operation offers a two-fold barrier against the usual mode of extension of infection from the uterus to the peritoneal cavity. Because of its low site, the greater part of the incision sinks into the pelvis immediately after its closure. Localization in the pelvic peritoneum, therefore, may be anticipated should infection extend through the wound. The double flaps of peritoneum offer an added protection. Within a short time after operation, they become adherent and thereby make the uterine wound extraperitoneal. If infection occurs, they are sufficiently united by the time that the uterine wound breaks down, to protect the peritoneal cavity from contamination. Thus they limit the infection to the subperitoneal tissues, from which drainage occurs spontaneously, either through the lower angle of the abdominal incision, or through the separated edges of the uterine wound into the cervix and vagina.

The twenty-nine cases operated upon according to the above described technique are reported in the five accompanying charts. Each chart shows the temperature after operation, the number of hours elapsed since the membranes ruptured, and the number of vaginal examinations made.

Charts 1 and 2 contain the records of 14 cases in which infection probably was not present. These are shown to illustrate the absence of morbidity after the usual temperature rise that follows the trauma of most operations.

Chart 3 differs from the former in that the first three cases show some later morbidity

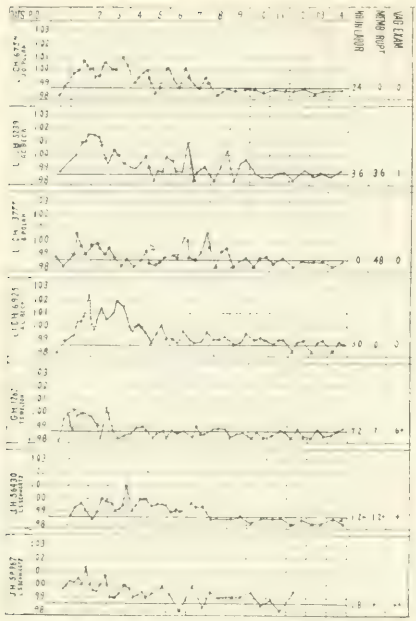


Chart 3.

which could not be explained. The rise in temperature in each case was not accompanied by an elevation of the pulse or a leucocytosis, and as a result was not attributed to infection.

Charts 4 and 5 include the pulse rate as well as the temperature. Although *uterine cultures were not made*, infection probably was present in the majority of the eight cases. None of these patients showed any signs of peritonitis, and as may be observed, instead of terminating fatally from this complication, the temperature reached normal in from 7 to 10 days after operation. Usually the fall in temperature was accompanied by, or followed shortly after, the appearance of pus in the lochia or abdominal wound.

The presence or absence of the three factors which influence morbidity and mortality following cæsarean section is shown in the three tables.

Table I.—The Duration of Labor Before Operation

| | |
|---|---|
| Not in labor | 4 |
| 5 to 10 hours in labor | 4 |
| 10 to 24 hours in labor | 5 |
| 24 to 36 hours in labor | 9 |
| 48 hours in labor | 7 |
| *Over 10 hours in labor* | *21* |
| *Over 24 hours in labor* | *16* |

Table II.—The Condition of the Membranes Before Operation

| | |
|---|---|
| Membranes not ruptured | 10 |
| Membranes ruptured less than 10 hours | 4 |
| Membranes ruptured 10 to 24 hours | 7 |
| Membranes ruptured 36 to 48 hours | 3 |
| Membranes ruptured 48 hours | 5 |
| *Membranes ruptured* | *19* |
| *Membranes ruptured over 10 hours* | *15* |
| *Membranes ruptured over 24 hours* | *8* |

Table III.—The Number of Vaginal Examinations Before Operation

| | |
|---|---|
| No vaginal examinations | 12 |
| One vaginal examination | 8 |
| Two vaginal examinations | 2 |
| Three vaginal examinations | 2 |
| Many vaginal examinations | 5 |
| *One or more vaginal examinations* | *17* |
| *Many vaginal examinations* | *5* |

Table I gives the duration of labor at the time of operation. Twenty-one of these patients had been in labor at least 10 hours, and sixteen had 24 hours or more of labor.

Table II shows the condition of the membranes at the time of operation. The membranes were ruptured in nineteen of the twenty-nine cases. Ten hours or more had elapsed since the rupture of the membranes in fifteen.

The number of vaginal examinations made before operation is given in Table III. Seventeen patients had one or more vaginal examinations. In five cases many examinations were noted.

One or all three of these morbidity factors was noted in twenty-five of the twenty-nine cases. While we may safely state that only four of the entire series were elective operations, it would be quite unfair to claim that all of the remainder were potentially infected, as the definition of this term is susceptible to considerable variation. However, allowing for the difference of opinion in this regard, most operators would have considered the majority to be in this class. The puerperium in only eight of them showed signs of infection and all recovered.

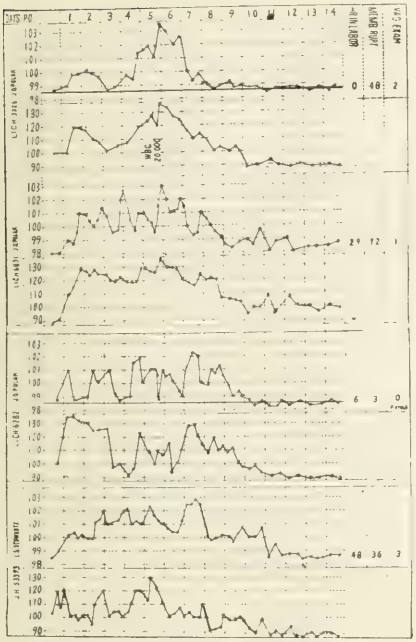


Chart 4.

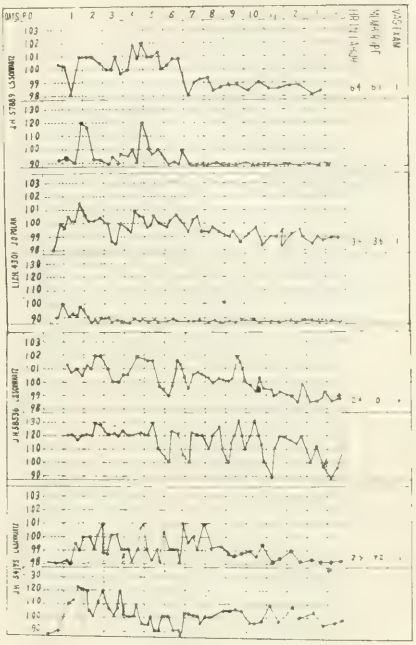


Chart 5.

These results no doubt are better than those which ultimately will be obtained in a larger series, since this technique does not protect against extension through the lymphatics and does not prevent possible contamination by the spilling of some of the amniotic fluid.

## CONCLUSIONS

1. Admitting the possibility of error in attempting to draw conclusions from a small series of cases, we feel that this technique will eliminate the consideration of an elective cæsarean section in border line cases of dystocia.

2. By permitting the use of an efficient test of labor, most of these patients will be delivered through the natural passages.

3. The few that fail may with some slight added risk be delivered by the use of the above described technique.

4. So-called potentially infected cases frequently are not infected. Whenever our opinion in this respect is erroneous, our technique does not sacrifice a non-infected uterus, and thereby preserves the functions of menstruation and reproduction.

5. While our results in the infected cases are better than may be anticipated in the larger series, they indicate that the mortality will be less than 10 per cent. As this is the admitted mortality of craniotomy as well as hysterectomy following cæsarean section in this class of cases, it would seem that the two-flap, low incision cæsarean section should be given the preference in all cases in which the child is alive.

I wish to thank Drs. J. O. Polak, T. S. Welton, and L. S. Schwartz, for the use of their records in the preparation of this paper.

# DANGEROUS INTRAPERITONEAL HÆMORRHAGE FROM UTERINE FIBROID

By J. LOUIS RANSOHOFF, M.D., F.A.C.S., and MAX DREYFOOS, M.D., Cincinnati

IT is customary to regard uterine fibroids as benign tumors, in so far as acute life-threatening complications are concerned. The operative cure is, as a rule, one of choice, undertaken because of the size of the tumor, pressure symptoms, metrorrhagia, or that chimera so frequently mentioned and so seldom seen—malignant degeneration. Intra-abdominal hæmorrhage from uterine fibroids is an extremely rare complication. It is not even mentioned in the ordinary textbooks of gynecology. Neither Kelly nor Crossen describe it, or even mention the possibility of its occurrence. Samson (1), in his comprehensive article on the blood supply of uterine myoma, mentions the possibility of intra-abdominal hæmorrhage, but describes no case. The bleeding occurs, as a rule, from the rupture of one or more dilated superficial veins, just beneath the peritoneum. In only two of the reported cases was the bleeding arterial. Any abdominal surgeon of even moderate experience has encountered these dilated varicose veins under the peritoneum of ordinary subserous fibroids, which, if ruptured, might well cause serious and even fatal intra-abdominal hæmorrhage. It is surprising that such hæmorrhages are not far more frequent.

In his textbook on pathology, published in 1861, Rokitansky mentioned a fatal hæmorrhage from ruptured varicose veins on the surface of the small subserous fibroid. This subject attracted little attention until 1905, when Stein (2) reported a case of fatal hæmorrhage in a woman of 44. In 1910 Brunner (3) was able to collect ten authentic cases. The cause of the rupture is not infrequently external trauma, and the bleeding vein, is as a rule, located in an exposed position, either on the dome of the tumor, or in one case, resting on the bony ridge of the sacral promontory. In many cases distinct evidence of trauma was obtained.

Steinbuchel's (4) case is of particular interest from an etiological standpoint. A symptomless fibroid had been present for many months; during an abdominal massage, given with the idea of dispersing the tumor there was a sudden violent pain which persisted on and off for 10 days. This was followed by collapse, with symptoms of intra-abdominal bleeding; operation revealed a necrotic fibroid with twisted pedicle. At the base of the pedicle was a dilated bleeding vein. Hysterectomy was followed by recovery.

The case of Zweifel (5) is, too, of unusual interest. A 27-year-old primipara died suddenly of intra-abdominal hæmorrhage, 40 hours after a miscarriage. Postmortem examination revealed a tremendous intra-abdominal hæmorrhage from numerous sieve-like perforations of varicose veins on the surface of a fibroid. It is not unlikely that here a virulent streptococcus infection may have played the important etiological rôle.

In Brunner's case, a 42-year-old nurse, the rupture followed the sudden strain of lifting a patient. There was a sharp pain in the abdomen, followed by immediate collapse; operation done after 2 hours revealed a tremendous hæmorrhage; hysterectomy was followed by prompt recovery.

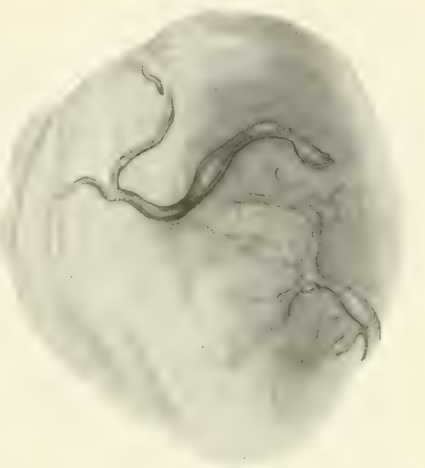
Jaschke's (6) case presents almost the same history. A 48-year-old wash-woman, while lifting a tub, had a sudden pain, followed by collapse. Operation done 10 hours later revealed a ruptured subperitoneal varix on the surface of the fibroid; hysterectomy was followed by death.

The etiology in Clark's (7) case was one of internal trauma. There was a subperitoneal fibroid wedged in the pelvis. The hæmorrhage was due to the erosion of a supravaginal vein from pressure on the sacral promontory. Operation was followed by a tedious convalescence accompanied by intestinal paralysis, but eventual recovery. A further case was reported by Sadlier (8), in 1913. In this case the source of the bleeding was a small ruptured

artery over the crest of the fibroid. There was no external trauma. The fact that all these cases occurred during the active sexual life of the individual is suggestive of the well known tendency of these tumors to shrink after the menopause.

It is not surprising that the diagnosis is so seldom made. In Brunner's case alone was the correct diagnosis made before operation. The extreme rarity of the condition makes the diagnosis almost impossible. There is an old saying that the most probable is always found; and who is likely to think of a condition so rare that very few surgeons even know of its existence? In the published cases various diagnoses were made: ovarian cyst with twisted pedicle, extra-uterine pregnancy, perforation of gastric ulcers, and in one case, appendicitis.

Miss W. S., aged 35, on July 10, 1920, while eating lunch, felt a sudden sharp pain in the lower part of the abdomen. There was more or less collapse, and she was taken home in an automobile. Since that time there has been continuous fever, and severe colic-like pains in the abdomen, accompanied by diarrhœa. Her family physician who first saw her made the diagnosis of appendicitis, which he later changed to uterine tumor. We saw her on the afternoon of July 13, 1920. There was a marked pallor and shallow respiration; temperature 101.4°, pulse 112. The pulse was not of good volume. Blood pressure was 110–60; leucocyte count 17,000; reds 3,500,000; hæmoglobin 50 per cent. Abdominal examination revealed a generally distended abdomen, tender to pressure. There was just over the pubes a tumor the size of a fœtal head, freely movable from side to side. Examination of this tumor caused pain. Rectal examination gave negative finding. Diagnosis: ovarian cyst with twisted pedicle. An immediate operation was done. Gas-ether anæsthesia was used. A mid-line incision was made and, on opening the abdomen, about 2 liters of free blood was found in the abdominal cavity. This blood was partly old and partly fresh. There was a large subperitoneal fibroid, which was quickly delivered into the wound. The bleeding was seen to come from two ruptured varicose veins on the anterior surface of the fibroid. During the operation the pulse became very rapid. A supravaginal hysterectomy was done, and the wound closed without drainage. While considering the advisability of a blood transfusion, the patient made so quick a postoperative recovery that this was considered unnecessary. Recovery was uneventful and she left the hospitlal at the end of 20 days. A week after leaving the hospital she developed a thrombophlebitis of the left leg, which completely subsided



Fibroid removed from author's case, showing two large varicose veins on anterior surface.

in the course of the following month. The specimen shows a large subperitoneal fibroid, with two ruptured varicose veins on the anterior surface.

It is probable from the history that after the rupture of these veins and effusion of blood into the abdominal cavity, the lowering of the blood pressure allowed clots to form in the openings. The clots were probably disturbed by the operative manœuvers, so that the bleeding again began. The fever and high leucocyte count were undoubtedly due to the absorption of the blood, and more or less substantiated the diagnosis of ovarian cyst with twisted pedicle.

Just one word in the treatment of this condition. In every reported case no matter how precarious the condition of the patient, a hysterectomy was done. In a case of this kind, in a desperate condition, it would be a more simple matter to transfix and ligate the bleeding vein on either side of the opening, and do a hysterectomy at some future time, after the recovery of the patient. In a desperate case, this would certainly be a life-saving measure.

*Additional case.* Since writing the above Dr. Dudley W. Palmer, of Cincinnati, has had

a similar case in his practice, which he has kindly allowed us to report in this article.

Mrs. J. T. W., age 50, referred by Dr. Allyn C. Poole. Some 5 years ago the patient weighed as much as 180 pounds; weight now 165 pounds. She had "catarrhal appendicitis" 12 years ago. She had had an indirect, inguinal hernia during the past 6 years, for which she has worn a truss. She never has been pregnant. Menses were normal until 2 years ago, since which time she has had some menorrhagia and metrorrhagia; no dysmenorrhœa.

Returning from the theater she was taken with a sudden attack of severe lower abdominal pain, followed shortly by vomiting. She vomited several times in the next 6 hours; pain increased, at which time she called the family doctor, who gave a morphine hypodermic. Pulse and temperature then became normal. There was some lower abdominal tenderness and rigidity, about equal on the two sides. During the next 12 hours pain rather cramp-like continued and she had occasional spells of vomiting. The first enema resulted in a large stool, and the two subsequent enemas produced no results other than a little mucus, bile, and charcoal, which she had taken the night before for the supposed gastritis.

Consultation was asked for 18 hours after onset, and the temperature was found then to be normal; pulse 86; lower abdominal rigidity and tenderness. The abdomen was distinctly distended. On vaginal examination, a small cervical polyp, not bleeding, was discovered. We could not map out the pelvic organs because of the rigidity and tenderness. On the tentative diagnosis of a probable obstruction of the bowel, operation was advised and accepted.

Operation January 13, 1921, Christ Hospital, 24 hours after the onset of symptoms. Catheterized specimen of urine was negative. On opening the peritoneum, large quantities of fresh blood and dark blood clots welled up. Blood was everywhere present in the abdominal cavity. Upon exploration of the pelvis, both tubes and ovaries were found to be normal. Four or five subperitoneal fibroids were left in the uterus, the largest about the size of a tennis ball. Examination of the liver, spleen, and mesentery vessels did not reveal source of hæmorrhage. The stomach was distended; no ulcerated area was palpable. Upon returning to the pelvis to deliver the fibroids, a rather large varicose vein, extending over the upper surface of the largest of the fibroids, was found to be bleeding profusely. This was the only source of the abdominal bleeding discovered. A rapid subtotal hystero-bilateral-salpingo-oophorectomy was made. The postoperative course has sustained the opinion as to the source of the intraperitoneal hæmorrhage and has been normal in every way except for an excess number of gas pains the first 72 hours.

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# DEPARTMENT OF TECHNIQUE

## THE SURGICAL TREATMENT OF ACUTE PELVIC INFECTIONS IN WOMEN

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IT is estimated that 75 per cent of the invalidism in women arises from pelvic infection. Women suffer from pelvic, abdominal, and back pains, disorders of menstruation, constipation, and its consequent toxæmia, reflex digestive disorders and all grades of neurasthenia, and the expression of focal infection in every form—cardiac, vascular, renal, and arthritic. At intervals there are acute exacerbations showing recurrence of the original infective process within the pelvis. Such recurrences require prolonged courses of expectant treatment, and during the time of treatment there is an ever extending and encroaching pathological destruction which either causes death or confirmed invalidism. It is especially with these acute exacerbations and with the primary attacks that this paper deals, for we wish to urge earlier and more radical operative treatment.

Recurrence of pelvic abscess after drainage through the cul-de-sac has been the rule. If one operates upon such cases at a later period, he finds the pelvic mass with its pockets of so-called sterile pus. This has convinced me that puncture of the cul-de-sac drains but one of the many pus pockets in the pelvis.

As a result of unsatisfactory experience with the then approved methods of conservatism, I have been prompted to do very radical surgery on these cases instead of waiting, for then the patient either died or became a chronic invalid. However much the cul-de-sac bulges with pus, the patient is operated upon through a median lower abdominal incision, so that all diseased tissue can be examined and treated surgically. Usually the cause of failure of the non-operative or expectant plan of treatment is that one fails to follow the known surgical principles in operating within the female pelvis, and such failure results disastrously because the knife does not excise all diseased tissue and the small wick drain fails in its purpose, for the original nidus, the infection atrium, remains, the cocci increase in number and invade the lymph and blood stream, and finally the patient succumbs. Anæsthesia, surgical shock, and the opening up of fresh areas for infection and absorption without removing the source, indeed cause more deaths, and with good reason, than would be the case if these traumata were not added to tax the patient's remaining powers of resistance.

It will be seen from the series of reports and from the outline of the histories that the pus pockets by no means regularly become sterile. It is more reasonable to assume that the individual acquires a temporary immunity, and as this immunity is gradually lost there results a recurrent exacerbation of acute inflammation with a further destruction of tissue and impairment of health. Years after the onset of the infection, many of these cases will be brought to the hospital with an acute, spreading or general peritonitis. We have reported in detail two cases who, 8 years after the onset, were operated upon during an acute exacerbation with general peritonitis.

In my opinion the greatest error in the operative treatment of these cases is insufficient surgery and inadequate drainage. The principles laid down by Joe Price and his successor, Kennedy, reach the highest degree of efficiency when applied to suppurative pelvic peritonitis. It is claimed that both the morbidity and mortality consequent to radical surgery in this condition are frightful. The reverse of this is my experience, and a review of the literature on this subject contributed during the last decade is convincing that mortality and morbidity following the non-operative, the expectant plan, and the conservative-surgical is frightful indeed. It is the purpose of the essayist to express a formula crystalized by experience into a somewhat definite plan for the management of these cases.

Immediate operation is done in all cases which present the syndrome of acute surgical pelvis, if first seen within 12 hours after the onset of the infection, which is ushered in by sudden, severe, abdominal pain, nausea, vomiting, chill, elevated temperature, irritable bladder, rectal pain, con-

stipation, abdominal rigidity and tenderness, all progressive, uninterrupted, and accompanied by a definite leucocytosis. It is especially advantageous that the operation be done before the expiration of the first 12 hours; a period of safety for patients and one difficult for diagnostic differentiation with the surgeon. If first seen 12 or more hours after onset a varying period of some hours of observation is followed, during which time absolute rest is given the patient, as compatible as possible with the routine and repeated examinations. A blood count is taken to determine the resistance of the patient and the severity of the infection, bacteriological examinations are made to ascertain the type of the bacteria with which one is dealing. As a rule there are two kinds of bacteria of genital origin, the streptococcus and gonococcus, and two of intra-abdominal origin from diverticulitis or appendicitis,—the streptococcus and the colon bacillus; other admixtures of bacteria are subsequent to or coincidental with the three named. The patient herself is taken into account more considerately than the laboratory findings concerning her. The most minute and painstaking examinations are made, employing all means at one's command for determining definitely the pelvic organs involved and the degree of involvement, not omitting a search for remote, coincidental, or complicating diseases, in which X-ray and cystoscopic examinations figure prominently: the pulse and temperature are taken, noting especially disparity between them; the expression of the face is noted; the condition of the tongue; the distention of abdomen; the amount of vomiting or degree of nausea; the severity of pain; the general appearance of well-being or lack of same; the activity of skin and kidneys; the relative difficulty of obtaining bowel evacuation; the passing of gas; and the changes that each few hours bring in any or all of these. During this time, the patient is supported by proctoclysis and hypodermoclysis of saline solutions containing glucose.

In the most acute, if seen before the eighth day after the onset, operation is deferred—

1. If the condition is apparently stationary or the symptoms take a more favorable turn during the 6 or 12 hours consumed in the preliminary study of the case;

2. When the blood examination reveals a high polymorphonuclear count without an accompanying leucocytosis or in the absence of an increasing number of leucocytes, *pari passu* with the appearance of the polymorphonuclears with each subsequent three or four hour total count. This is important for a high polymorphonuclear count with a relative leucopænia indicates an intense infection in a subject with little or no resistance—one probably so overwhelmed that a fatal issue is to be expected regardless of any and all treatment;

3. From the third to the seventh day after onset—when the severity of the peritonitis is at its height and the rest method is being given a chance to have effect, as evidenced by improvement of symptoms—then the operation should be withheld in the absence of an exigency until the more acute general symptoms have subsided.

Do not defer operation—

1. In the presence of a progressive exaggeration of unfavorable symptoms during the period of rest, observation, and expectant treatment;

2. If there is sudden relief of pain with a subjective sense of improvement, accompanied by an acceleration of pulse rate and frequently by a lowering temperature, usually indicating thrombosis, or rupture of a localized abscess;

3. When there is a sudden fall in a previously high leucocyte count or a decreasing number of leucocytes and an increasing percentage of polymorphonuclears, which indicates a falling resistance;

4. When more than one week has elapsed since the onset of the infection, for the blood during this period of time will have developed in all probability a degree of immunity to the limit of its opsonic power;

5. When a mass appears in the pelvis—evidence of the localization of the infectious process by adhesions within a circumscribed area.

It is most frequently more than a week after the onset before the patient is referred to the surgeon and a pelvic mass is almost invariably found, and for such a delay of more than 12 or 24 hours for examination and preparation for operation is all that is usually required.

Laparotomy is done through a median lower incision. Abdominal pads or rolls of dry gauze pack off the non-adherent intestines and non-invaded portion of the abdominal cavity. In the course of a great many operations done on these cases, it is found that the sooner these operations are done after the onset of the infection the less dense are the adhesions, the more easily the diseased adnexa can be separated and the shorter the convalescence. The fundus of the uterus is the landmark. It is hugged by the dissecting finger in the line of cleavage between the adherent mass and the uterus, bladder and broad ligament. Blunt dissection is done, cutting only the more resistant bands until the dissecting finger reaches

the cul-de-sac; the ends of the tubes usually found on the pelvic floor are freed. From below upward, the finger sweeps laterally from the posterior surface of the uterus over the surface of the broad ligament, feels and liberates the adherent tube and ovary and lifts them into the operative field. In the intraligamentary types of abcess the adhesions of intestines and omentum to the mass are separated, the broad ligament incised between the round ligament and fallopian tube, affording access to the pyogenic wall, which may be dissected out with the finger, frequently without rupturing it. Should it appear that hysterectomy is advisable, the broad ligament is clamped close to uterus down to the reflection of bladder, the uterovesical fold is incised, and the bladder freed from the uterus and cervix by blunt dissection. In subtotal hysterectomy a cone is excised from the cervical stump, including the glands and cervical mucosa. If a total hysterectomy is to be done a tenaculum forceps catches the vagina close to the cervix and another the lower end of the cervix; the vagina is then opened between the two tenacula and cut from the cervix uteri at its reflection. The uterus is removed by incisions with knife or scissors close to the clamps on the broad ligament. The ovarian and uterine arteries are ligated individually, if exposed; if not, by mattress sutures through the broad ligament close to the clamps. If the patient is under 35 years the best ovary is left, if it is not infected. The vaginal opening is closed by a lockstitch or interrupted figure-of-eight suture of No. 2, 10 or 20 day chromic catgut. A running lockstitch of the same is carried on either side of the cut broad ligament. As soon as the clamp is removed the edges are inspected for active bleeding; additional figure-of-eight sutures are employed to effect complete hæmostasis, and the raw edges of both broad ligaments are united with a running lockstitch or interrupted mattress suture. The entire denuded portion of the pelvic floor is covered with iodoform gauze overlaid with rubber dam if denudation is extensive; if not, rubber gloves with strips of gauze run through fingers after cutting-off tips are used.

If the abscess is intraligamentary the front layer of the broad ligament only is stitched to its opposite and the posterior left free, thus making its cavity one and continuous with the denuded pelvic floor. The abdominal gauze pads are now removed and counted. The intestines are allowed to fall forward and downward touching the rubber which overlays the gauze. The omentum, which frequently has been ligated in sections on its lower border in freeing it from the mass, is carefully laid in its normal position in the abdomen, never drawn down, nor tucked around the rubber and gauze drainage. In no case is the rubber drain removed before the seventh day. Where the drain is voluminous, and this is the rule, it is simply loosened up after a week, and during the next 3 or 4 days a gradual complete removal is done. As soon as the patient is anæsthetized, hypodermoclysis of saline and glucose is commenced and 1 or 2 quarts introduced. Before the peritoneum is closed 1 or 2 quarts of hot water are given per rectum as suggested by Clarke, and the sigmoid and colon freed from kinks or twists as they are filled.

*Postoperative treatment.* The head of the bed is elevated, continuous proctoclysis of tap water is given for 24 hours, and thereafter of glucose, soda, and saline, interrupted every 6 hours by rectal flushing and siphonage; in the more severe cases hypodermoclysis of glucose and saline 1 quart every 8 hours is administered. When nausea and vomiting is excessive, gastric lavage is done every 6 to 8 hours. Morphine or codein with atropin is given hypodermically in sufficient doses to relieve suffering and afford rest and sleep. Water by mouth is withheld, or is given in restricted amounts, an ounce every hour until vomiting stops, when it is increased; liquid nourishment is withheld until vomiting and nausea ceases. The bowels are moved on the fourth day by purgatives and enema.

## CONCLUSIONS

Failure to remove the focus of infection renders the operation relatively valueless; for when the source remains it is to be expected that the severity of the infection will increase, the contiguous structures will become involved, and remote metastases will more certainly result.

Pelvic *débridement* is urged, at least the pyogenic membranes with infected tubes, uterus, and ovaries should be removed.

Gauze packs are applied over denuded pelvic surfaces to stop oozing and to hinder capillary absorption, thus limiting further extension of the infection.

Eroded or denuded intestinal surfaces are peritonized, or overlaid with omentum.

Rubber dam covers the gauze packs and the pelvic operative field, minimizes the formation of adhesions, and drains freely and continuously.

The gauze and rubber ends are brought out through the lower end of the incision, and transfixed with a safety pin.

The abdominal incision is closed in layers and snugly around the drains.

The dressings over the incision should be voluminous, and changed as often as soiled to keep up capillary suction.

The results which have followed this plan are the saving of life, shortening to a marked degree the postoperative period of recovery, the elimination of a prolonged morbidity, the relatively earlier restoration to health and resumption of the normal activities of the woman.

### SUMMARY OF CASE REPORTS

In three years ending August 1, 1920, there have been 255 pelvic inflammatory cases operated upon consecutively, with 1 death. In this series there were 80 hysterectomies, the death occurring in this class; and 76 double salpingectomies. Of those who had either one tube or one ovary, or one tube and one ovary removed there were 98. No subsequent pregnancies have occurred in this number to date.

One hundred sixty-three have been followed up, the longest period for 3 years, the shortest 4 months. Of this number 137, or 34 per cent, are cured; that is, in good physical health and free from symptoms. Eighteen, or 11.1 per cent, are improved; 8 or 4.9 per cent, not improved. In this number those are included who are not improved for other reasons; e.g., two of them are goiter cases, goiter developing since operation.

Thirty-one had double oophorectomies done. Twenty-six, or 83.5 per cent, of these were entirely cured of symptoms. Three, or 9.6 per cent, have improved. Two, or 6.9 per cent, have not improved. It is noticeable that the percentage of cures in cases who have had both ovaries removed is relatively the same as those who have had one or none removed.

Average hospital days 23.3, including one neurotic, who spent 109 days in hospital.

The case reports herewith appended are the 163 cases, whose postoperative course has been followed. They were compiled by Dr. D. H. Doherty, from my service at Burwell's Hospital and the Vaughan Memorial Hospital.

ONE HUNDRED SIXTY-THREE CASES WHOSE POSTOPERATIVE COURSE HAS BEEN FOLLOWED

| Name | Operation | Days in Hospital | Result |
|---|---|---|---|
| Mrs. A. W. L. | Left salpingectomy, oophorectomy, appendectomy | 17 | Cured. |
| Mrs. G. J. | Double salpingectomy, hysterectomy, appendectomy | 28 | Cured. |
| Mrs. G. B. E. | Double salpingectomy, hysterectomy, appendectomy | 18 | Cured. |
| Mrs. D. S. McK. | Hysterectomy, left oophorectomy, (tubes and appendix removed at previous operation) | 18 | Cured. |
| Mrs. C. D. | Hysterectomy, left oophorectomy | 27 | Cured. |
| Mrs. H. W. H. | Double salpingectomy, left oophorectomy, appendectomy | 27 | Cured. |
| Mrs. F. H. | Hysterectomy, right oophorectomy, double salpingectomy | 13 | Cured. |
| Mrs. C. L. Y. | Right salpingectomy, oophorectomy, appendectomy | 14 | Cured. |
| Mrs. H. L. P. | Right salpingectomy, oophorectomy, appendectomy | 18 | Cured. |
| Mrs. E. M. P. | Double salpingectomy, right oophorectomy, appendectomy | 13 | Cured. |
| Mrs. W. C. McD. | Double salpingectomy, hysterectomy | 24 | Cured. |
| Mrs. J. K. | Double salpingectomy, appendectomy | 25 | Cured. |
| Mrs. R. S. | Hysterectomy, right oophorectomy, appendectomy | 36 | Improved. |
| Miss B. G. | Right salpingectomy, oophorectomy, appendectomy | 30 | Improved. |
| Mrs. J. W. K. | Double salpingectomy, hysterectomy | 24 | Cured. |
| Mrs. B. B. | Right salpingectomy, oophorectomy, appendectomy | 18 | Cured. |
| Miss A. F. | Double salpingectomy, hysterectomy, appendectomy | 24 | Not improved |
| Mrs. W. C. H. | Double salpingectomy, appendectomy | 21 | Improved. |
| Mrs. W. N. E. | Double salpingectomy, oophorectomy, appendectomy | 16 | Cured. |
| Mrs. E. F. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| Mrs. L. L. S. | Double salpingectomy, left oophorectomy | 31 | Improved. |
| Mrs. G. T. W. | Double salpingectomy, appendectomy | 39 | Improved. |
| Mrs. C. J. E. | Double salpingectomy, appendectomy | 19 | Cured. |
| Mrs. I. F. | Double salpingectomy, appendectomy, hysterectomy | 36 | Cured. |
| Mrs. J. M. N. | Double salpingectomy, appendectomy | 41 | Improved. |
| Miss R. W. | Double salpingectomy, hysterectomy, left oophorectomy, appendectomy | 24 | Cured. |
| Mrs. G. W. | Right salpingectomy | 19 | Cured. |
| Mrs. J. T. T. | Double salpingectomy, appendectomy | 14 | Cured. |
| Mrs. C. W. I. | Double salpingectomy, appendectomy, hysterectomy | 28 | Cured. |
| Mrs. J. C. L. | Double salpingectomy, appendectomy, hysterectomy | 24 | Improved. |
| Mrs. W. E. B. | Double salpingectomy, hysterectomy | 20 | Cured. |
| Mrs. C. L. C. | Double salpingectomy, appendectomy | 25 | Improved. |
| Mrs. G. F. W. | Double salpingectomy | 18 | Cured. |
| Mrs. J. D. B. | Double salpingectomy, appendectomy | 28 | Cured. |
| Miss L. M. | Double salpingectomy, appendectomy | 16 | Improved. |
| Mrs. A. J. M. | Right salpingectomy, hysterectomy, appendectomy | 13 | Cured. |

| Name | Operation | Days in Hospital | Result |
|---|---|---|---|
| Mrs. F. M. D.... | Double salpingectomy, hysterectomy, appendectomy | 31 | Cured. |
| Mrs. W. H. D... | Double salpingectomy, appendectomy | 23 | Cured. |
| Mrs. S. G. P.... | Double salpingectomy, hysterectomy, appendectomy | 32 | Not improved |
| Mrs. H. A. W... | Double salpingectomy, hysterectomy, appendectomy | 33 | Cured. |
| Mrs. G. W. F.... | Right salpingectomy, oophorectomy, appendectomy | 19 | Cured. |
| Miss E. B..... | Left oophorectomy, appendectomy | 17 | Cured. |
| Mrs. W. R. W... | Double salpingectomy, hysterectomy, appendectomy | 27 | Cured. |
| Mrs. P. M. C.... | Right oophorectomy, appendectomy | 25 | Cured. |
| Mrs. S. H..... | Double salpingectomy, oophorectomy | 24 | Cured. |
| Mrs. O. M. R... | Double salpingectomy, appendectomy | 21 | Cured. |
| Mrs. M. B..... | Double salpingectomy, appendectomy | 21 | Cured. |
| Mrs. R. L. L.... | Double salpingectomy, appendectomy, left oophorectomy | 26 | Improved. |
| Mrs. F. C. K.... | Left salpingectomy, oophorectomy, appendectomy | 23 | Not improved |
| Mrs. J. M. C.... | Double salpingectomy, hysterectomy, appendectomy | 46 | Cured. |
| Miss M. G..... | Double salpingectomy, oophorectomy, appendectomy | 41 | Cured. |
| Mrs. D. A. M... | Double salpingectomy, appendectomy | 26 | Improved. |
| Mrs. M. M. C... | Double salpingectomy, appendectomy | 32 | Cured. |
| Miss A. L. A.... | Double salpingectomy, appendectomy, left oophorectomy | 19 | Not improved |
| Mrs. B. M..... | Double salpingectomy, appendectomy | 19 | Cured. |
| Mrs. D. G..... | Right salpingectomy, oophorectomy, appendectomy | 14 | Cured. |
| Mrs. W. R..... | Right salpingectomy, oophorectomy, appendectomy | 13 | Cured. |
| Miss M. F..... | Right oophorectomy, appendectomy | 13 | Cured. |
| Mrs. F. D..... | Double salpingectomy, hysterectomy | 15 | Cured. |
| Miss B. D..... | Double salpingectomy, hysterectomy, appendectomy | 20 | Improved. |
| Miss F. G..... | Right salpingectomy, oophorectomy, appendectomy | 13 | Cured. |
| Mrs. W. K. P... | Right salpingectomy, appendectomy | 23 | Cured. |
| Mrs. C. R. C.... | Left salpingectomy, oophorectomy | 16 | Cured. |
| Miss L. R..... | Right salpingectomy, double oophorectomy, appendectomy | 11 | Cured. |
| Mrs. J. W. R.... | Double salpingectomy, oophorectomy, hysterectomy, appendectomy | 21 | Cured. |
| Mrs. R. J..... | Double salpingectomy, oophorectomy, hysterectomy, appendectomy | 22 | Cured. |
| Mrs. R. H..... | Double salpingectomy, oophorectomy, appendectomy | 20 | Cured. |
| Mrs. H. A. D... | Double salpingectomy, oophorectomy, hysterectomy, appendectomy | 31 | Improved. |
| Mrs. F. W. M... | Left salpingectomy, oophorectomy, appendectomy | 18 | Cured. |
| Miss A. B. H... | Right oophorectomy, appendectomy | 12 | Cured. |
| Miss W. H..... | Right oophorectomy, appendectomy | 14 | Improved. |
| Mrs. W. I. S.... | Double salpingectomy, left oophorectomy, hysterectomy | 31 | Cured. |
| Mrs. L. N..... | Left salpingectomy, appendectomy | 15 | Cured. |
| Mrs. J. W. O'B.. | Right oophorectomy, appendectomy | 18 | Improved. |
| Mrs. J. H. B.... | Double salpingectomy, right oophorectomy | 21 | Improved. |
| Mrs. T. H. B.... | Double salpingectomy, hysterectomy | 22 | Cured. |
| Mrs. W. P. N... | Left oophorectomy, appendectomy | 16 | Cured. |
| Mrs. I. P..... | Double salpingectomy, | 16 | Cured. |
| Mrs. J. P. N.... | Double salpingectomy, oophorectomy, hysterectomy, appendectomy | 24 | Not improved |
| Mrs. E. E. H.... | Double salpingectomy, hysterectomy | 36 | Not improved |
| Mrs. J. W. R.... | Double salpingectomy, appendectomy | 16 | Cured. |
| Mrs. T. H. M... | Double salpingectomy, oophorectomy, hysterectomy, appendectomy | 40 | Cured. |
| Mrs. W. M..... | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| Mrs. J. S..... | Left salpingectomy, oophorectomy, appendectomy | 20 | Cured. |
| Mrs. W. H..... | Double salpingectomy, hysterectomy, appendectomy | 39 | Cured. |
| Mrs. W.H. McG. | Double salpingectomy, hysterectomy, appendectomy | 14 | Cured. |
| Miss M. C..... | Double salpingectomy, left oophorectomy, appendectomy | 15 | Cured. |
| Miss O. W..... | Double salpingectomy, hysterectomy, appendectomy | 18 | Cured. |
| Mrs. O. B. F.... | Double salpingectomy, hysterectomy, appendectomy | 23 | Cured. |
| Mrs. E. J. P.... | Double salpingectomy, left oophorectomy, appendectomy | 21 | Cured. |
| Miss A. L. B.... | Right salpingectomy, oophorectomy, appendectomy | 109 | Not improved |
| Mrs. G. C. T.... | Left salpingectomy, oophorectomy, appendectomy | 54 | Not improved |
| Mrs. S. E. R.... | Double salpingectomy, oophorectomy, appendectomy | 29 | Cured. |
| Mrs. D. C. D.... | Left salpingectomy, oophorectomy, appendectomy | 30 | Cured. |
| Miss A. B..... | Double salpingectomy, hysterectomy, oophorectomy | 58 | Cured. |
| Mrs. T. E. C.... | Double salpingectomy, left oophorectomy, appendectomy | 41 | Cured. |
| Mrs. N. M. S.... | Double salpingectomy, right oophorectomy, appendectomy | 22 | Improved. |
| Mrs. W. H. B... | Left salpingectomy, oophorectomy | 48 | Cured. |
| Mrs. W. M. B... | Double salpingectomy, hysterectomy, appendectomy | 33 | Cured. |
| Mrs. R. N. M. G. | Double salpingectomy, appendectomy | 18 | Cured. |
| Mrs. D. G. C.... | Double salpingectomy, oophorectomy, appendectomy | 18 | Cured. |
| Miss G. S..... | Double salpingectomy, appendectomy | 21 | Improved. |
| Mrs. L. M. M... | Right oophorectomy. appendectomy | 18 | Cured. |
| Mrs. R. L. H.... | Right salpingectomy, oophorectomy. appendectomy | 23 | Cured. |

| Name | Operation | Days in Hospital | Result |
|---|---|---|---|
| Mrs. J. A. R. | Right salpingectomy, oophorectomy, appendectomy | 23 | Cured. |
| Miss R. D. | Left salpingectomy | 23 | Cured. |
| Colored: | | | |
| D. E. | Double salpingectomy, hysterectomy, appendectomy | 19 | Cured. |
| T. A. | Double salpingectomy, oophorectomy | 24 | Cured. |
| E. R. | Double salpingectomy, oophorectomy | 19 | Cured. |
| L. C. | Double salpingectomy, hysterectomy, appendectomy | 18 | Cured. |
| P. W. | Double salpingectomy, oophorectomy | 21 | Cured. |
| I. B. | Double salpingectomy, oophorectomy | 17 | Cured. |
| A. L. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| M. D. | Double salpingectomy, oophorectomy | 21 | Cured. |
| P. S. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| M. G. | Double salpingectomy, oophorectomy | 17 | Cured. |
| S. R. | Double salpingectomy, oophorectomy, appendectomy | 17 | Cured. |
| L. P. | Double salpingectomy, oophorectomy, appendectomy | 21 | Cured. |
| P. S. | Double salpingectomy, left oophorectomy, hysterectomy, appendectomy | 21 | Cured. |
| M. G. | Double salpingectomy, oophorectomy | 17 | Cured. |
| M. M. | Double salpingectomy, hysterectomy | 21 | Cured. |
| E. W. | Double salpingectomy, hysterectomy | 23 | Cured. |
| S. H. | Double salpingectomy, oophorectomy, appendectomy | 21 | Cured. |
| M. J. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| B. C. L. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| G. B. | Double salpingectomy, oophorectomy, appendectomy | 21 | Cured. |
| S. P. | Double salpingectomy, oophorectomy, appendectomy | 21 | Cured. |
| B. M. | Double salpingectomy, oophorectomy, appendectomy | 18 | Cured. |
| S. B. | Double salpingectomy, oophorectomy, appendectomy | 21 | Cured. |
| E. W. | Double salpingectomy, hysterectomy, appendectomy | 22 | Cured. |
| F. A. | Double salpingectomy, oophorectomy, appendectomy | 27 | Cured. |
| H. D. | Double salpingectomy, hysterectomy, appendectomy | 17 | Cured. |
| M. O. | Double salpingectomy, hysterectomy, appendectomy | 32 | Cured. |
| A. J. | Double salpingectomy, oophorectomy, appendectomy | 24 | Cured. |
| D. M. | Double salpingectomy, hysterectomy, appendectomy | 26 | Cured. |
| L. M. | Double salpingectomy, hysterectomy, left oophorectomy, appendectomy | 21 | Cured. |
| M. F. | Double salpingectomy, oophorectomy, appendectomy | 17 | Cured. |
| A. S. | Double salpingectomy, appendectomy | 14 | Cured. |
| S. A. | Double salpingectomy, oophorectomy, appendectomy | 19 | Cured. |
| C. S. | Double salpingectomy, appendectomy | 20 | Cured. |
| L. W. | Double salpingectomy, left oophorectomy | 29 | Cured. |
| E. B. | Double salpingectomy, appendectomy | 17 | Cured. |
| L. H. | Double salpingectomy, right oophorectomy, appendectomy | 32 | Cured. |
| M. M. | Double salpingectomy, left oophorectomy, appendectomy | 24 | Cured. |
| I. McW. | Double salpingectomy, right oophorectomy | 21 | Cured. |
| M. S. | Double salpingectomy, oophorectomy, appendectomy | 18 | Cured. |
| L. C. | Double salpingectomy, left oophorectomy, appendectomy | 21 | Cured. |
| E. M. | Double salpingectomy, appendectomy | 23 | Cured. |
| G. R. | Double salpingectomy, appendectomy | 33 | Cured. |
| M. M. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| C. H. | Double salpingectomy, right oophorectomy, appendectomy | 18 | Cured. |
| L. W. | Double salpingectomy, right oophorectomy, hysterectomy, appendectomy | 21 | Cured. |
| C. D. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| M. F. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| H. B. | Double salpingectomy, hysterectomy, right oophorectomy, appendectomy | 31 | Cured. |
| S. S. | Double salpingectomy, oophorectomy, appendectomy | 17 | Cured. |
| A. P. | Double salpingectomy, right oophorectomy, appendectomy | 18 | Cured. |
| T. H. | Double salpingectomy, right oophorectomy, appendectomy | 23 | Cured. |
| A. C. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| S. C. | Double salpingectomy, oophorectomy, appendectomy | 21 | Cured. |
| W. L. | Left salpingectomy, oophorectomy, appendectomy | 21 | Cured. |
| A. W. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |
| R. L. | Double salpingectomy, hysterectomy, left oophorectomy, appendectomy | 24 | Cured. |
| M. F. | Double salpingectomy, hysterectomy, appendectomy | 21 | Cured. |

The following complete case histories are presented as illustrative of the four different types usually found.

Case 1. M. G., age 38, single, complained of abdominal pain, nausea and vomiting. The family history was negative. About 9 years ago, patient says that she had an attack similar to this and had a vaginal operation with drainage, and was in the hospital 1 month. Since then she has had three or four similar attacks, although she has gone for a year or longer without one. Her appetite and digestion are poor, she has no nervous symptoms. The

menses have been irregular and nearly always painful. She has had no bladder trouble. She has lost 15 pounds in weight. Two days before admission the patient was seized with abdominal pain, and suffered with fever, nausea and vomiting, was unable to retain nourishment, and was constipated.

Physical examination showed a thin, emaciated, anæmic woman, with pale conjunctivæ, good teeth, slightly enlarged tonsils. Temperature, 101°; pulse, 86; respiration, 24. The neck, chest, and extremities were negative. The abdomen was not distended, was tender over both lower quadrants, and there was definite muscle rigidity. Vaginal examination showed the urethra and cervix normal. The uterus felt normal in size and was slightly movable. A mass about the size of a lemon was felt on the left side, and a mass somewhat smaller on the right side. A vaginal scar is present in the cul-de-sac from the previous colpotomy.

Blood examination showed 8,700 white blood cells; polymorphonuclears, 80 per cent; mononuclears, 20 per cent; negative for malaria. Urine examination showed reaction, acid; specific gravity, 1016; albumin, 1 plus; sugar, negative; microscopic pus, 3. Blood pressure was 115 systolic, 85 diastolic.

The patient was treated expectantly as above described and on the fifth day the temperature reached 103.6°, pulse 124, respiration 29. The urine was negative. The blood examination showed white blood cells, 11,600; polymorphonuclears, 92 per cent; mononuclears, 8; Widal, negative. Blood culture was negative, Wassermann, negative. Patient was operated upon this day. Diagnosis: acute double salpingitis. Gas-ether anæsthesia was used. Hypodermoclysis of glucose and saline was given. A low mid-line incision was used. On opening the abdomen we found a double salpingitis with a large infected left ovary, the size of an orange. The right ovary was also infected and enlarged. The appendix was long and the tip was bound to the right pelvic mass. Both tubes, ovaries, and appendix were removed, and an iodoform gauze and rubber drain inserted. On section both tubes and left ovary were found to be filled with pus. The drain was gradually removed until on the sixteenth day it was completely out, and a tube was inserted for 6 days. The patient was dismissed on the thirty-eighth day, and the wound was completely healed. Convalescence was uninterrupted.

Case 2. Mrs. P., age 38, housewife, complained of pain in stomach, fever and nausea. The family history was negative. Patient has had the usual diseases of childhood. Eight years ago she had an attack similar to the present one and since that she has had several attacks. She has been very nervous and irritable, and has been unable to do ordinary housework on account of weakness. She states that she has had continuous pain in the back. Appetite and digestion are poor, bowels constipated; menses irregular and painful. She has had leucorrhœa for several years. At times there is burning on urination. She has three children, the youngest 9 years old. She has had no miscarriages. She has lost 20 to 25 pounds in weight in last 3 or 4 years.

About 2 days before entering the hospital patient was seized with pain in lower part of abdomen. The pain was very intense and cramp-like. She was nauseated and vomited since onset. The bowels have not moved.

Physical examination showed a thin, emaciated patient, with cheeks flushed, and suffering. Temperature was 102°; pulse, 130, respiration 30. The head, neck, chest, and extremities were negative. The abdomen was distended. Palpation was difficult on account of tenderness and rigidity, which are more marked in lower quadrant. Vaginal examination showed the cervix lacerated, leucorrhœal discharge, urethra normal in appearance, no discharge. On bimanual palpation a definite mass is felt on both sides, movable and apparently bound down. The uterus is retroverted, the cul-de-sac bulging. Diagnosis; acute exacerbation of a chronic pelvic cellulitis.

The patient was operated upon morning after admission. Hypodermoclysis of glucose and saline was started. Gas-ether anæsthesia was used and operation was done through lower mid-line incision. When the abdomen was opened, a quantity of turbid fluid escaped. The intestines and peritoneum were violently red, showing a general peritonitis. The omentum and a loop of intestine were firmly adherent to a pelvic mass. By the technique described above, the omentum and intestines were freed, and the tubes and ovaries brought into the field of operation. The tubes were red, swollen, and contained pus. Total hysterectomy and salpingectomy were done. The right ovary was left. Iodoform gauze and rubber drain inserted, and wound closed. For the first week after operation, drainage was very abundant. The drain loosened on the tenth day and was gradually removed until on the sixteenth day removal was complete. Patient was discharged from hospital on twenty-seventh day. She had gained 12 pounds in weight and felt fine.

Case 3. Mrs. McD., age 22, housewife; complained of pain in abdomen, rigors, fever, vaginal discharge. The family history was negative. Patient had had usual diseases of childhood. She had never been severely sick before present illness. She has one child 2 weeks old, has had no miscarriages. Menses began at 16, normal and regular. Two weeks ago patient was delivered of a normal child by her physician. Three days later she began to have high fever, rigors, pain in abdomen, nausea, and vomiting, with bowels constipated.

Physical examination showed an emaciated, nervous woman, with flushed face; lips dry and cracked; tongue dry; temperature, 105.6°; pulse, 140; respiration, 40. The head, neck, chest, and extremities are negative. The abdomen was scaphoid, not distended, lower quadrant tender, with marked muscle rigidity. No masses were felt. Vaginal examination showed the cervix lacerated, œdematous, red, with mucopurulent discharge. The urethra was normal, uterus enlarged, soft, movable. Large tubes could be palpated. Cystoscopic examination showed a mild cystitis, ureteral orifices normal. Catheterized specimen from each ureter was free from pus.

Blood examination showed white blood cells, 17,400; hæmaglobin, 75 per cent; polymorphonuclears, 88 per cent; mononuclears, 12 per cent; transitionals, 2 per cent. Malaria, negative; Wassermann, negative (subsequent). Urine examination showed reaction, acid, specific gravity, 1020; albumin, sugar, pus. Microscopic examination showed pus cells. Examination of catheterized specimen from ureters showed no albumin, no sugar, and microscopic negative. Blood pressure, systolic 120, diastolic 115. Diagnosis: puerperal infection.

Patient was operated upon day of admission, under gas-oxygen anæsthesia. Hypodermoclysis of glucose and saline started. A lower mid-line incision was made. A small amount of turbid fluid was found, the intestines were packed off, the uterus was found enlarged, red, and soft. Both tubes were swollen and of a firey red color. Both tubes and the uterus were removed by technique described above. Iodoform gauze and rubber glove drain inserted. Three days after operation temperature came down to normal. Patient discharged from hospital on eighteenth day, cured.

Case 4. L. L. M., colored, age 19, single, complained of pain in abdomen and swollen joints. The family history was negative. Patient has always been well until present

illness. Probably was infected 2 months before admission. Patient had had the usual diseases of childhood. She has no indigestion, the bowels are regular, she has no sore throat or tonsillitis. Menses began at 15, and have been regular. Urination has been painful for past 2 months. The day before admission to hospital, pain began in lower part of abdomen, was somewhat more severe in right side than left. She did not vomit although she was nauseated. Urination was frequent and painful. The night before admission the fingers and left wrist became swollen and painful.

Physical examination showed a well-nourished negro girl, suffering. The tongue was coated, the teeth good, the tonsils normal, the pharnyx normal. Temperature, 102°, pulse, 100; respiration, 24. The neck shows no glandular enlargement. The heart and lungs are negative. The abdomen is slightly distended, and there is extreme tenderness throughout the entire lower portion, with marked muscle rigidity. No masses are felt. The left wrist and joints of first two fingers of left hand are swollen, hot, and tender. Vaginal examination shows the cervix red. Bartholin's glands are palpable. The mouth of the urethra is red and swollen. A definite mass is felt on each side of the uterus which is bound down and adherent. The cul-de-sac is slightly bulging.

Examination of the blood shows white blood cells 10,800; red blood cells, 4,800,000; polymorphonuclears, 82 per cent; mononuclears, 16 per cent; transitionals, 2 per cent; Wassermann, negative. Urine examination shows reaction, acid; specific gravity 1016; albumin, none; sugar, none; and microscopic examination shows pus cells. Smear from the urethra shows gram positive and negative diplococci. Diagnosis: gonorrhœal salpingitis and arthritis.

The patient was operated upon the day after admission. Ether anæsthesia was used. Hypodermoclysis of saline was started as soon as patient was anæsthetized. A midline incision was made and the omentum was found to be bound down to pelvic organs. By the technique described the tubes were delivered into the field of operation. The tubes were red, swollen, and covered with flakes of fibrin. The left ovary was enlarged, and of a purplish, grayish color. Both tubes and left ovary were removed. The appendix was removed also. Iodoform gauze overlaid with rubber dam was used as drains and the wound closed. On the fourth day after operation the swelling in the wrist and fingers disappeared. The drain was removed on the eighth day. Patient dismissed on seventeenth day, with wound completely healed and free from symptoms.

## AXIOMATIC REVIEW IN PARALLEL

| CONSERVATIVE | RADICAL |
|---|---|
| "Fresh inflammatory conditions are a *noli tangere* for operative interference." | "In 1885 Lawson Tait had gained the reputation of curing suppurative peritonitis by laparotomy, extending his fame throughout England and the continent of Europe; he gained this by radical excision." |
| "The treatment of all puerperal infections should be entirely medical, as surgical procedures are more injurious than helpful. The treatment of non-puerperal pelvic infections in the acute period is also chiefly medical." | "In acute cases defer operation sufficiently long for the individual to develop immunity, while in subacute and in the acute recurrent cases immediate operation is the safe and wise procedure." |
| "Treatment: Absolute rest. Purgatives. Application of ice or heat and light. Restriction of diet, unless it is evident that free effusion has taken place in the peritoneal cavity, or that pus sacs are in Douglas pouch when either colpotomy or laparotomy is advised." | "As the surgeon treating war wounds found excision of necrotic and infected tissues (*débridement*) lessened mortality and morbidity, and was the surest way to obtain primary union, so also the abdominal surgeon removed the focus of infection as the primary and fundamental basis of surgical treatment." |
| "Many patients with acute salpingitis recover and remain permanently well without surgical intervention." | "When the tubes and ovaries are infected, the proper procedure is to remove them entirely." |
| "Opening the abscess by the vagina, even in acute stages often saves life and results in permanent cure." | "Gonococcic peritonitis is a perforative peritonitis from rupture of pyosalpinx or an ovarian abscess." |
| "In from 9 to 12 months a closed pyosalpinx will have become sterile." | "In the virulent infections of the streptococcal type it may be one of the most dangerous conditions that can confront the surgeon, when associated with disease of the ovaries and extensive suppuration of the tube, the possibility of cure in the sense of restoration of function is impossible." |
| "The gonoccoccus rarely causes peritonitis." | "If the salpingitis is of gonococcal origin, the hope of future pregnancy is practically nil, and the operation should be as extensive as conditions require." |
| "In those pyogenic infections exclusive of the gonococcal type, in time the organism has run its course and is generally dead; not so, however, with the gonococcus, which may remain latent indefinitely." | "The majority of gonococcal pus tubes removed are quiescent and the organism responsible for the infection has long since died." |
| "It patients do not die from general peritonitis, it is because the pus is walled in by adhesions and its spread limited." | "When a pus pocket forms it may erode into bowel and discharge its contents. Such a sac is never completely emptied It partly empties itself and then primarily closes and the reaccumulation reopens it. Such a course may continue for a period of years, or until the strength of the patient is exhausted." |
| "The separation of adhesions is quite easily accomplished in acute cases, but we seldom operate on the acute cases, so that by the time the surgeon encounters these adhesions they are firm and dangerous to deal with." | "Severe menorrhagia and leucorrhœa persist after bilateral salpingectomy." |
| "The more I operate, the less I drain. Drains may even embarrass the peritoneum, diminishing its resistance. In the very weak it is better to drain and not depend too much on the peritoneum's resistance to infection, but | "In sexually mature women, hystero-salpingo-oophorectomy is followed by a lower mortality, and a greater certainty of restoration than is possible after conservative operations." |
| | "The after-care of salpingitis patients is mea |

to drain, for many women have died a week after pelvic operations from a spreading peritonitis, who would have been saved by drainage at the time of operation."

"Gauze packing in the peritoneal cavity has no place in modern surgery."

sured by the life of the individual, unless all organs which are the various habitats of the gonococcus are removed; these are the uterus, tubes, Skene's and Bartholin's Glands."

"The least rapid convalescence seems to follow the conservative operation while the most rapid is after hysterectomies."

## STATISTICS COLLECTED FROM LITERATURE

Of 91 cases reported of rupture of pyosalpinx as a cause of diffuse peritonitis 54 died; 36 were not operated upon and all died, a mortality of 100 per cent. Of 55 cases operated upon, 18 died. Of 19 cases operated on in 12 hours 2 died. Brickner: Surg., Gynec., & Obst. 1912 May.)

Fourteen per cent with closed abdominal incision suppurated when the pelvic drain was brought through the cul-de-sac into vagina. No suppuration of wound occurred when drain was brought out through abdominal incision. In 145 cases of resection of tubes 50 obtained symptomatic cure, three became pregnant. (Ballard: Am. J. Obst., 1919, May.)

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# THE TREATMENT OF GONORRHŒA IN THE LOWER GENITO-URINARY TRACT IN WOMEN

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GONORRHŒA in women may be regarded as a two-stage disease. In the first stage the disease is limited to the cervix and lower genital tract; in the second stage the infection has spread upward and involved the corporeal endometrium, tubes, ovaries, and pelvic peritoneum. These two stages are quite distinct clinically. In the first stage the symptoms are comparatively mild, and unless a suburethral or a Bartholinian abscess develops, there is comparatively little pain; in the second stage, however, there are well-marked symptoms, the condition, for want of a better term, often being spoken of as pelvic inflammatory disease, although the latter may be the result of micro-organisms other than gonococci.

In the first stage, except during the acute period, a positive diagnosis is frequently made only with difficulty, even by the specialist. The discharge is often scanty, and gonococci are usually demonstrated with difficulty, and only after repeated examinations. In many of the cases in this stage the diagnosis is not made, and not a few never apply for treatment unless intraperitoneal lesions have developed. As a rule, the treatment generally extended to patients in the first stage of the disease is less effective than that given to any other class of patients. An occasional local treatment and the employment of a vaginal douche, often without adequate instructions as to how the latter is to be administered, constitutes practically all the treatment many of these patients receive. A douche is of value for its cleansing effect, and perhaps in a slight degree because of the bactericidal properties of its constituents; unless, however, it is supplemented by other measures, it is useless so far as its curative properties are concerned.

The statement has often been made that the average obstetric case receives less efficient medical care than does any other class of patients—a statement that is even more applicable to the woman suffering from gonorrhœa of the lower genital-tract. There are many reasons for this: The disease is essentially chronic, and yields slowly to treatment; the patients do not suffer acutely, and are, indeed, often almost free from symptoms, so that it is frequently difficult to get them to persist in the treatment until a cure has been effected. This, coupled with the fact that it may be inadvisable to acquaint the patient with the nature of her disease, renders the treatment doubly difficult. This is particularly the case with dispensary patients. Many cases suffer frequent reinfection, and in these patients treatment is without avail unless they can be induced to change their mode of living.

The necessity for treatment during the first stage of the disease is obvious, since the danger of extension of the infection upward, with the development of serious complications that often require mutilating operations for relief, is too well recognized to require comment. The necessity for observing prophylaxis, both of the patient and of those with whom she is brought into contact, is also of the utmost importance.

In men the early stage of the disease is usually well-marked and painful, and the patients therefore seek treatment early; in the terminal stages the symptoms are often mild or almost absent, and it is then that the man is especially prone to spread the gonorrhœal infection. Such patients, while aware that they have had the disease, often believe themselves cured. The woman, on the other hand, is likely to be a disseminator of infection during the first stage of the disease, at which time her symptoms are mild and she may not even be aware that she is an incumbent of gonorrhœa.

The gonococcus is in many respects a remarkable organism and possesses peculiar properties. It is easily killed by heat or cold. Its growth is inhibited or it is killed more or less rapidly by room temperature. Desiccation destroys the gonococcus. It is grown only with difficulty in artificial media; it requires a special medium and will not grow in most of the ordinary culture-media. The medium must possess the proper reaction. The micro-organism must be grown at a certain definite temperature, slight departures from which will inhibit its growth. To obtain the best results the medium must be inoculated directly, to prevent the suspected material from becoming chilled. In artificial media the gonococcus produces at best but a scanty growth, and must frequently be subcultured. It is easily crowded out by other more rapidly growing micro-organisms. It is readily killed by extremely weak dilutions of any of the ordinary antiseptics. Nevertheless, despite these peculiarities, the

organism, when in the female genital tract, exhibits a marked chronicity and a resistance to treatment that are perhaps its chief characteristics. The student may well ask himself the reason for these apparently divergent properties of the gonococcus. The first explanation that is likely to be made is that the gonococcus possesses more marked vitality in man than when grown in artificial media, and this assumption may be somewhat strengthened by the fact that the organism is pathogenic only to man. The correctness of this explanation is, at least, doubtful. A more probable theory would be that our treatment does not reach the micro-organisms and the organisms have extended to the deeper tissues, as they have done in practically every case that applies for treatment.

Luys [1] states that surface gonorrhœa is cured with ease, but that the disease is continued by reinfection of micro-organisms from the deeper layer of the tissue. The experiments of Derby [2] and others have shown that the local action of silver nitrate, corrosive sublimate, and certain other gonococcids is retarded greatly by the addition of serum. All gonococcids lose their efficiency more or less in the presence of mucus. It is probable that the chronicity of gonorrhœa in the female and its resistance to treatment are not due to any marked vitality of the organism and unusual resistance to the ordinary gonococcids, but to the fact that, during the customary treatment, the bactericid does not reach the deeper situated gonococci, which are constantly producing reinfection from below. This theory is greatly strengthened when we consider the efficacy of the Credé prophylactic treatment for ophthalmia neonatorum. In this condition the gonococci are virulent organisms. The susceptibility of the conjunctiva to this form of infection is well known, yet one drop of a 1 per cent silver nitrate solution instilled in the eye will, with the greatest regularity, destroy the organisms and prevent the development of conjunctivitis. The efficiency of prophylactic treatment for venereal disease as employed with our military forces during the recent war is further proof of this fact. It has been shown that, beyond doubt, if the prophylactic treatment is properly applied within a certain definite time limit after exposure gonorrhœa will very rarely result. In these instances the gonococci are virulent and are implanted upon soil favorable for their development. As long as the micro-organisms are limited to the surface and the gonococcid, not too diluted, can be brought into contact with them, so long can the development of the disease be inhibited. If the prophylactic treatment is applied after the micro-organisms have had time to reach the deeper tissues, the treatment is futile. In an effort to apply this theory to the treatment of gonorrhœa of the lower genital tract of the female the following plan has been evolved. The poor results of the treatment as often applied are probably due to the structural peculiarities of the female genital tract, which prevent the gonococcid from reaching the organisms in the depths of the tissue.

The three areas in which the gonococcus lodges and from which it is most difficult to eradicate the infection are the cervical glands, Skene's tubules in the urethra, and Bartholin's glands. All these areas contain more or less deep, tortuous, and mucus-bearing glands. In view of the necessity of eradicating the disease, it would seem rational therefore, as a preliminary measure, to attempt to destroy, as far as possible, the harboring places of the gonococci.

*Bartholin's gland.* Bartholin's gland is situated in the lower and posterior portion of the labia majora, partly under the bulbocavernosus (sphincter vaginæ) muscle. In some subjects it is entirely covered by the muscle, whereas in others it is partly embedded in the spongy tissue of the bulb. The gland extends posteriorly to the triangular ligament. Normally, it is about the size of a small bean, but it varies quite markedly, even in health, and according to the age of the patient. Atrophy of the gland occurs at the menopause. The duct is about 1.5 centimeters in length and 1.5 to 3 millimeters in diameter. It runs upward and inward. A differentiation between infection of the duct and that of the gland should be made. Every case in which a gonococcal macula is present does not suffer from a gland infection. If the gland is enlarged, swollen, or tender it should be excised. In this connection it should be remembered that the normal gland cannot, as a rule, be palpated except occasionally in thin subjects. In some long-standing cases the gland is firm and sclerotic—the so-called "adenitis glandulæ Bartholinæ scleroticans" of Saenger. More often it is somewhat swollen and tender, and occasionally suppuration takes place. The statement has been made that a Bartholinian abscess does not form except in the presence of a mixed infection. Whether or not a mixed infection is present is of no great moment, so far as the treatment is concerned. In any event, if the gland is infected, the surest and quickest treatment consists of excision. Infection of the duct yields quite readily to injections.

[1] Luys, G. Traité de blennorragie et de ses complications. Paris. 1912.
[2] Derby, G. S. Boston M. & S. J. 1906, September 27.

In those cases in which this treatment is not effective it is likely that the gland is involved, and in such patients excision of the gland is advisable. This surgical procedure may be facilitated by making a preliminary forcible injection of methylene-blue solution. In some cases, especially the sclerotic variety of bartholinitis, the staining fluid will often not reach the entire gland, but even then the blue-stained tissue is a useful guide in performing the excision. If the gland is excised care should be taken to remove the entire structure and duct, thus eliminating one of the three chief harboring-places for the gonococcus. Stevens and Heppner [1] have recently urged the excision of infected Bartholinian glands.

Urethritis, in contradistinction to skenitis, is a transient disease, and generally clears up in a week or thereabouts whether or not treatment is instituted. In infection of Skene's tubules, however, the condition persists for prolonged periods. Skene's tubules are usually two in number and about 1 centimeter in length; they lie in the floor of the urethra and run parallel to it, their openings being situated in the urethral floor, just within the external urinary meatus. The destruction of those tubules is a simple procedure, and may be accomplished either with a cautery needle or by splitting them up through an operating urethroscope. The fact that a third or a fourth gland may be present should be borne in mind. Schueller [2] has especially directed attention to these supernumerary glands. By splitting up the glands in the floor of the urethra this structure is converted into a fairly straight tube, to which gonococcids can subsequently be applied effectually.

*Cervix.* In dealing with gonorrhœa of the cervix, a more difficult problem is encountered. The cervical glands are deep, branched, filled with mucus, and penetrate for some distance into the myometrium. In addition to this the arbor vitæ are pronounced, and when infection is present, these ridges are swollen, so that the cervical canal contains many crypts and folds, all of which are filled with thick tenacious mucus. Trachelectomy (Sturmdorf operation) may be the logical procedure, but the difficulty of excising all the infected mucosa, the danger of spreading the infection upward or of destroying the barrier formed by the internal os, and perhaps the slightly increased danger of the operation, should influence the surgeon against adopting this form of treatment except in very stubborn cases. The fact that many of the patients are young women and may subsequently become pregnant, and that under such circumstances dystocia may result from operation should also be borne in mind. A better method consists in thorough dilatation of the lower portion of the cervical canal and the application of a gonococcid. Findley [3] has suggested this treatment, and finds that by its use the duration of the cervical infection can be greatly reduced. It may subsequently be found necessary to repeat the dilatation a few times. Care must be exercised not to dilate the internal os; if this should accidentally be done, the uterine cavity should be swabbed with an efficient gonococcid. A little care will, however, prevent this accident. A solid dilator is a convenient instrument with which to perform the dilatation. A shoulder may be fitted on it, to prevent too deep penetration. The performance of trachelectomy should be reserved for those cases that do not yield to other means. If either of Bartholin's glands are infected, a good plan is to administer nitrous oxid and perform all the operations at a single sitting. If it is subsequently found that one of the glands in the floor of the urethra has been overlooked, this may be slit up under local anæsthesia. It will usually be found necessary to dilate the cervix more than once, but if the first dilatation has been a thorough one, subsequent dilatation can generally be performed under local anæsthesia. The method just described permits the operator to apply treatment to the depths of the diseased tissues, and should be considered as a preliminary to efficient treatment. In itself it is not curative, except in so far as Bartholin's gland is concerned, when the latter is excised.

The choice of the gonococcid is important. Although the gonococcus is relatively easily destroyed by most antiseptics, some possess greater gonococcidal properties than others, and some penetrate more deeply and are less likely to undergo chemical change in the presence of mucus than are others. Mercurochrome, mercurophen, and Dakin's solution are all satisfactory gonococcids. An oily or sticky solution is the most preferable one to use. Dakin's solution in 1,2, or 5 per cent strength, made up with olive oil, is extremely efficacious. Of far greater importance than the choice of a gonococcid are the thoroughness and regularity with which the treatment is carried out. This is particularly true of the treatment of the cervix, where the preliminary cleansing and removal of the mucus prior to the application of the gonococcid are of the utmost importance. It should be remembered, for example, that if the disease in the urethra is cured and the in-

[1] Stevens, W. L., and Heppner, M. J. Am. M. Ass., 1909, lii, [illegible]

[2] Schueller, [illegible] Berlin. klin. Wchnschr., 1898, xxxv, no. 16.

[3] Findley, P. Am. J. Obst., 1910, lxxxi, [illegible]

fected cervix is neglected, the former structure will in a short time probably become reinfected. For this reason the treatment should be so intensive as to eradicate the infection from all adjacent areas. A point that, in my opinion, is often overlooked is that it is useless to attempt treatment in a woman who is being frequently reinfected. Therefore, in married patients, the necessity of securing treatment for the husband is apparent. The employment of methylene-blue, or the incorporation of this or of some other staining material in the medication which the patient is to apply herself, has been advocated. In itself methylene-blue is a more or less efficient gonococcid, although it is probably inferior to certain others. The plan is, however, a useful one, since the operator can determine by the amount of stain whether or not the patient has been regular in her treatments. In loose women the staining of the vulva may also act beneficially in preventing coitus. The employment of methylene-blue, or the incorporation of this substance with other gonococcids, is of greater value in the treatment of dispensary than of private patients. During the menstrual period especial effort should be made to prevent the upward extension of the infection. With this end in view all local treatment should be suspended at the menstrual epoch, and the patient should be kept in bed in the Fower position, or at least confined to her room. The administration of small doses of atropin has been advised.[1] Watson[2] believes that coitus is a potent factor in the upward extension of the infection. It is a significant fact that in Findley's[3] series of cases, which was composed of loose women, he remarks upon the infrequency of pelvic inflammatory disease. However, apart from the question of the rôle played by coitus in the upward spread of the infection, for prophylactic reasons, and to prevent reinfection, continence should be practiced. The only danger from this treatment is that the dilatation of the cervix may result in the upward spread of the infection. In the hands of a careful surgeon this risk is slight. The author has employed this treatment in 17 cases with good results. This form of treatment materially shortens the duration of the disease. This fact should be borne in mind because the longer the infection is present in the lower genital tract the greater is the likelihood of an upward spread of the disease.

The above treatment is not recommended as a routine method for all cases. It is, however, advisable in those cases which have proved intractable to less radical procedures.

[1] Norris, Charles C. Gonorrhœa in Women. Philadelphia and London, 1913, p. 242.

[2] Watson, D. Gonorrhœa and its Complications. New York, 1914.

[3] Findley, P. Ibid.

# EDITORIAL

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. .....Managing Editor
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SEPTEMBER, 1921

## STANDARDIZATION OF HOSPITAL STATISTICS

Sir Berkeley Moynihan has remarked: "Statistics can be made to tell anything, even the truth." Buckle, in his *History of the Civilization of England*, profoundly influenced the thought of his time by his masterly use of statistics. He arrayed known but little appreciated facts in such manner that they became mountain peaks on the skyline of knowledge and gave perspectives which were as fascinating in their greatness as the materials of which they were made were common and sordid. Buckle showed that given a large city, such as Paris, where reasonable statistics are available, happenings ordinarily supposed to be accidental may be foretold a year in advance; for example, the number of legs broken, and which leg, and the number of suicides. He also showed the relation of the cheapness of food to marriage and fecundity and that the theological modifications of the Christian religion are due primarily to environment. Buckle died at the age of 41, after publishing the two introductory volumes of his work. In our day, however, even statistics are influenced by the exaltation of the minute and the exaggeration of details which produce, not mountain peaks on the skyline, but ant hills under foot, and for perspective, ash cans at the back door filled with statistical rubbish.

Great credit is due to Codman for his unselfish labor in collecting valuable data with regard to the results of operations for sarcoma of the bone. The Scandinavian countries are collaborating in collecting statistical reports of great magnitude, and are using the journal of their organization for the publication of results.

At a meeting of the Board of Regents of the American College of Surgeons held in Boston recently, it was decided to make available the statistics of the wealth of pathological material in the hospitals of this country. Such statistics, properly compiled, would illuminate many dark pages in our book of knowledge. The value of mass research in this field lies not only in the discovery of an occasional new peak on the pathological skyline, but also in giving body to current opinions not as yet accepted for want of basis in pathological fact. The great success of the American College of Surgeons in its campaign for the standardization of hospitals has been owing to the fact that the work has been confined to a few vital problems. Had it been complicated by many problems it would have failed in its purpose.

To the inexperienced it may appear to be a simple matter to secure comparable data, for instance with regard to the operative mortality of different hospitals, but this is by no means the fact. The personal equation of the surgeon, his skill and experience, and his pride in his statistics, may control the results to a marked extent. At the present time each

surgeon has his own method of estimating mortality and with some care in window dressing, groups of statistics which are justly comparable can be made to show remarkable but misleading differences in percentages. In estimating mortality, it should be clearly stated whether the percentages are based on the number of operations or the number of patients. A number of small operations may be performed on a patient, and if he dies the death rate apparently is reduced, although he is just as dead as though he had died from the first operation. Difficulties are encountered, too, if such patients leave the hospital after the first operation, and die outside the hospital before the later stages of the operation can be performed, although a complete one-stage operation might have been done, thus making it very difficult to obtain comparable statistics. This is particularly true of cases of malignant disease in which the type of cases chosen for operation controls the mortality, and operability is the chief consideration. We must not forget, however, that the death of the patient defeats the purpose of the operation, and methods that will reduce the death rate to the smallest possible extent are essential. The American College of Surgeons has undertaken a great task of collective investigation, the details of which must be carefully worked out.

William J. Mayo.

# TRANSACTIONS OF SOCIETIES

## CHICAGO SURGICAL SOCIETY

Regular Meeting Held April 1, 1921, Dr. William Fuller, Presiding

Dr. David J. Davis read a paper on "The Distribution of Hæmolytic Streptococci in the Body."

Dr. Gatewood read a paper on "Cholecystenterostomy from an Experimental Standpoint."

### FRACTURE OF THE TRANSVERSE PROCESSES OF THE LUMBAR VERTEBRÆ

Dr. George G. Davis read a paper on "Fracture of the Transverse Processes of the Lumbar Vertebræ." (See p. 272)

#### DISCUSSION

Dr. C. C. Rogers: I was much pleased to hear the paper of Dr. Davis although the symptoms in some of the cases I have had do not tally with those described by Dr. Davis. I looked over some of my cases today, and I have a report of 7 cases that are interesting from the standpoint of fracture of the transverse processes of the lumbar vertebræ.

The first of these was a girl who fell from a horse in Denver in 1906. She was taken to a hospital, and although, as Dr. Davis says, the pain in his cases was produced in the back, this girl had no pain in the back, all the pain was in the right knee. She went about on crutches for 14 months without any relief from the pain in her knee. The transverse processes of the third and fourth vertebræ were removed in 1907. The girl improved and made an uninterrupted recovery. She was a show girl, dancing on the stage, and inside of 6 months she was back dancing, and as far as I know she is still following that occupation. I have not heard from her for 3 or 4 years.

The second case I had in 1910 was that of a girl who was injured in an accident on 13th Street of this city. She was taken to the County Hospital, and her pain was all in the knee. A cast was applied to the knee and allowed to remain on for 3 weeks. When the cast was taken off she had as much pain as she had before. She was sent home. She came back to the hospital again in 1910, and X-ray examination showed fracture of the third and fourth lumbar vertebræ on either the right or the left side, I don't remember which now. These processes were removed and the girl made an uninterrupted recovery.

I have had four cases where there was no pain whatever in the back so far as symptoms were concerned. All four of these cases had this symptom: when they were lying on the back they could flex the leg upon the thigh and the thigh upon the abdomen, but they could not extend the leg. They walked with canes or crutches and got well after the operation.

Another patient was going down stairs, stubbed her toe, fell three steps, was picked up, and taken home. Her pain was referred to the back. She went on for weeks and finally had the processes which were fractured removed and she got well.

A Mr. B. fell out of a cherry tree 5 years ago and fractured the transverse processes. His pain was referred to the back. Of the seven cases I looked up, the pain was referred to the knee on the corresponding side in four cases. In three of them the pain was referred to the back.

In one of the seven cases the injury was produced by a wagon tongue striking patient in the lumbar region. First the patient had the appendix removed. This gave no relief of the symptoms. Later the kidney was explored with negative findings for stone. After being unable to work for 1 year the fractured transverse processes were removed and the pain was completely relieved.

Five of the seven cases were females, two males.

I mention these cases because a year or two ago a paper was read before this society on pain in the knee and at that time I asked whether any pictures had been taken of the back and I was told emphatically there was no reason for taking a picture of the back, and I sat down.

Dr. B. F. Lounsbury: I have been very much interested in Dr. Davis' paper. In our work we have a large number of traumatic cases. Large corporations have been in the habit of looking skeptically on any man who complains of pain for a long time without demonstrable lesion and we have found it necessary to differentiate between a sprain of the back and some graver condition. I know in the past a great many cases have been considered malingerers who have been suffering from a serious lesion. Since our X-ray technique has been improved sufficiently to get a good roentgenogram of the spine, it has not been uncommon to pick up one of these fractures of the transverse processes.

Recently we had a case of fracture of the pelvis which was complicated by a fracture of all of the transverse lumbar processes on one side, and three on the opposite side. These cases have happened

in working men with good heavy musculature. At first I thought them due to direct violence, but I can see from what Dr. Davis has said that muscular strain is the etiological factor. The disability varies. I have not removed any of the transverse processes of the vertebræ, and ultimately all the men have returned to work.

Dr. D. B. Phemister: I would like to ask Dr. Davis if he has found in consulting the literature that pseudo-arthritis is frequently associated with this condition. I have seen it, as shown in the slides, in two instances. In one case the injury extended to the lower lumbar vertebra. It struck me as a coincidence that one should see it in three instances. Probably traumatism has something to do with its development.

Dr. Roger T. Vaughan: In the differential diagnosis of these fractures of the transverse processes I have seen a condition referred to as "pseudo-fracture" of the transverse process. It is not always easy to differentiate these "pseudo-fractures" from genuine fractures and diagnostic errors are not infrequently made by surgeons who are not thoroughly familiar with the normal anatomic variations in this region as revealed by the X-ray.

It is important to remember that the transverse processes may lie horizontally or may lie obliquely either upward or downward, and one transverse process may extend out horizontally and the process on the other side of the same vertebra may lie obliquely upward or downward as in one of the cases which Dr. Davis has just shown us on the screen.

Not infrequently the terminal portion of the process, which arises from a separate center of ossification, as you know, is considerably denser than the proximal portion. Consequently one may definitely visualize the lateral portion of the process lying at a marked angle to the horizontal as compared with its opposite fellow, and so be misled to diagnose as lines of fracture certain muscle outlines, bowel contours or other soft part markings which cross the pedicle of the transverse process more or less transversely or obliquely. Even with stereoscopic duplitized films double screened and with the Potter-Bucky diaphragm, it is not always easy to secure clear visualization of all details of the transverse processes in fat or heavily muscled patients.

Dr. Harry E. Mock: Dr. Phemister touched on an important point. I recall one case of fracture of the transverse process which, after rest in bed, healed, but pain continued, and an X-ray picture showed osteo-arthritis with some of the vertebræ higher up also involved.

A point of medico-legal importance is whether the osteo-arthritis existed prior to the injury, and caused the pain after the fracture had healed. I would like to know if these pictures showed that osteo-arthritis had developed since the fracture. In other words, were there lipping and other arthritic changes present when the first X-ray, shortly after the fracture occurred, was made?

Dr. Gatewood: I have seen two instances in miners of the same type of fracture of the transverse processes of the lumbar vertebræ from indirect violence, from blows on the head, the shoulder, or upper part of the back. In at least one instance, and I am not sure about the other, there was osteo-arthritis. It is of common occurrence among the older miners. The idea occurred to me that the reason for the fracture was that in an osteo-arthritic condition fractures more readily occur.

Dr. Davis (closing): I was very much interested in Dr. Rogers' remarks about the pain being in the region of the knee. In one case I had a patient complain of pain along the leg; that patient also had a fracture of the ilium, and I figured that the patient had, in addition to fracture of the transverse processes, enough pathology to account for the pain in the region of his knee. But I did not see it in any other case.

In answering Dr. Phemister's question, I would state that I have not seen anything in the literature concerning the association of a fracture of the transverse process and osteo-arthritis of the spine, nor of osteo-arthritis as a factor in the etiology of fracture of the transverse process, but vertebræ manifesting these signs of osteo-arthritis may be in such a condition as to predispose the person to fracture.

Dr. Vaughan has called attention to errors in diagnosis in the condition he terms "pseudo-fractures of the transverse process." Another possible error in diagnosing these conditions is found in the first lumbar vertebra. It is possible in a poor picture to misinterpret the relationship of the shadow of the lateral portion of the quadratus lumborum as it passes over the first transverse process for a fracture of the same.

Dr. Mock has called attention to the importance of the medico-legal aspect of the associated findings of osteo-arthritis and fracture of the transverse process. It would, indeed, be difficult to state accurately to what extent pain on bending is due to the fracture of the transverse process and how much is due to osteo-arthritis, and it is quite possible that many cases complaining of pain for a long time following the transverse process fracture may be in reality due to osteo-arthritis.

# CHICAGO SURGICAL SOCIETY

Regular Meeting Held February 4, 1921, Dr. William Fuller Presiding

## OSTEOMYELITIS OF THE FOREARM; NERVE SUTURE

Dr. Frederick G. Dyas reported two cases and exhibited the patients.

The first case I show you is one of osteomyelitis of the forearm, the musculospiral nerve having been injured at the operation. Patient had the classic wrist-drop, and the nerve was accordingly sutured with catgut, care being taken not to put too much tension on the severed ends, and, at the same time, to prevent, if possible, any muscle or fascia falling in between the severed ends. The arm was put up in a cock-up splint immediately in order to prevent elongation of the extensor tendons, and the wound has practically healed now. There is a little bleeding from the granulations. The operation was done in October. At this time, February 4, there is complete restoration of function.

Sometimes we get an idea that the length of time for regeneration and restoration of function is really longer than it actually is. I think the length of time that the nerve is allowed to go before suture makes a great difference in the time of restoration of function. In this case suture was done immediately.

## INJURY TO THE ANTERIOR TIBIAL NERVE AND TENDON

The other case of nerve suture was for an injury to the anterior tibial nerve and tendon. This young man was riding a motor cycle and fell off. The flange of the wheel cut in at the situation where you can see the scar, and immediately he had foot-drop. The nerve was sutured 24 hours later, and at the time of operation an electric excitor was used to be sure that in the wound secretions and blood we were getting the correct tissues together. It was very easy to get a reaction by applying the electrode to the distal segment of the nerve. The tendon was sutured at the same time. The sutures were put in such a way as to take in the neurilemma, doing as little damage as possible to the substance of the nerve. His foot was kept in dorsal flexion by a wire spring splint. He was allowed to go around with this sort of arrangement, which is merely a piece of wire bent to keep pressure upward upon the sole of the foot. It is very light and almost inconspicuous, so that he was given no trouble from heavy braces or a cast, or anything of that sort. He has received some massage and electrical treatment. He has complete restoration of function. The operation was done the first day of July last, and he is able to dance and to do almost everything.

These cases are unusually interesting showing the time of restoration of function when suture of the nerve has not been delayed following the severance of the nerve.

Dr. William Hessert described a case of enormous diverticulum of the duodenum.

Dr. Harry Mock read a paper entitled "Reconstructive Surgery and the Economic End-Results, Illustrated by a Case of Congenital Absence of Arms."

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

THIS volume[1] is evidence of most meritorious enterprise on the part of an American publisher. The father of medicine has never before been authoritatively presented to an American audience by an American publisher. This fact may in part account for the fact that to most of us, the name Hippocrates represents rather a hallowed shibboleth, a more or less shadily mythical tradition, rather than a vital living force.

As soon as the summer dog days are over and the lure of books returns with longer cooler evenings, every medical man who possesses or aspires to possess medical culture, should secure this estimable volume for the spare hours' collection on his reading table.

The preliminary discourse will give him a pen picture, in short compass, of early Greek medicine, that is admirably stimulating. It may even lead to deeper delving into Baas, or Haeser, or Pagel. If the reader belongs to the group of ultramoderns, he will experience the joy of blunting the conceit of his modernity.

The body of the book is devoted to a translation of Hippocrates' works: On Ancient Medicine, On Airs Waters and Places, On the Prognostics, On Regimen in Acute Diseases, On Epidemics, and On Injuries of the Head. Each one of these works is translated into flawless English and is preceded by a so-called argument, in which the reader is furnished valuable and interesting historical and critical data, largely explanatory in nature.

The second half of the book (vol. 2) follows the same general plan and is devoted to the books: On Fractures, On the Articulations, Mochlcus, Aphorisms, On Ulcers, On Fistulæ, On Hæmorrhoids and On the Sacred Disease (Epilepsy was so called in Early Times).

This is not an appropriate place to examine critically either Hippocratic doctrines or the various commentaries thereon. Adams handles very fully both of these important phases. But this decidedly is the place to emphasize the significance of this book to every practitioner of medicine.

M. G. SEELIG, M.D.

PROSTATIC surgery, probably the most spectacular surgery that is done at the present day, is again called to our attention by the new edition at Freyer's[2] hands. This father and master of prostatic surgery is surely in position to put pap into the mouth of the suckling infant surgeon, so far as surgery of the prostate is concerned.

This little volume consists of a series of lectures on prostatic surgery, dealing almost entirely with prostatic hypertrophy or enlargement as the author chooses to term it. Each lecture is amply illustrated by case history and photographs and drawings of the prostate in question.

It might be stated that the author in his lectures does not devote as much attention to kidney function and the method of its estimation as might be desirable; nevertheless his results indicate that unusual judgment has been exercised as to the time of operation and pre-operative treatment, no doubt with this constant element of danger in mind. Another factor —speed—is constantly dwelt upon. No doubt in a serious case, in spite of high toxicity an eight to fifteen minute anæsthesia with a complete prostatectomy does not jeopardize the life of the patient more than the casual cystostomy by the unskilled operator.

Any surgeon doing prostatic surgery should read this little volume as it has much in store for him.

J. A. WOLFER, M.D.

THE *Collected Papers of the Mayo Clinic* for 1919[3] are at hand. It is always with the greatest pleasure this volume is reviewed, as it constantly affords even the regular reader of the surgical periodicals an agreeable surprise. This volume is of exceptional interest, as it covers a wide field of work. For the ultra-scientist those papers by Kendall on the chemistry of thyroxin, studies on cholesterol by Luden, and studies on influenza-pneumonia by Rosenow are of exceptional value. The average surgeon as well as the internist and general practitioner finds an enormous amount of material on many topics that are of interest. The commonplace subjects are not neglected, and one finds a number of articles dealing with unusual conditions. The great satisfaction in reading these papers is that each is prepared in such a thorough manner and elaborated by extensive laboratory and

[1] THE GENUINE WORKS OF HIPPOCRATES TRANSLATED FROM THE GREEK WITH A PRELIMINARY DISCOURSE AND ANNOTATIONS. By Francis Adams, LL.D., Surgeon. Two Volumes in One. New York: William Wood and Company. 1921.

[2] CLINICAL LECTURES ON ENLARGEMENT OF THE PROSTATE; WITH A DESCRIPTION OF THE AUTHOR'S OPERATION OF TOTAL ENUCLEATION OF THE ORGAN. By Sir Peter J. Freyer, K.C.B., M.D., M.Ch., M.A., LL.D. (Honoris Causa), Nat. U. I. 5th ed. New York: William Wood & Co., 1920.

[3] COLLECTED PAPERS OF THE MAYO CLINIC, Rochester, Minnesota. Vol. xi, 1919. Edited by Mrs. M. H. Mellish. Philadelphia and London: W. B. Saunders Co., 1920.

clinical data that can come only from such a clinic as the Mayo clinic where nothing is taken for granted and where there is a wealth of material as well as a wealth of enthusiasm and facilities to carry on extensive experimental and laboratory work.

It is interesting to note that the present volume is a compilation of the papers of fifty-four individuals, the work of one year; surely an enormous contribution to medical literature and especially so since each paper is a definite contribution to our medical literature. Those papers written by William J. Mayo and Charles H. Mayo are of exceptional interest as they incorporate the mellow and mature thought of men ripe in experience who can see far into the future. These men are to medicine today what the prophets of old were to their peoples. One can truthfully say there is no single volume of medical literature today which affords the reader more real pleasure and profit, and more diversity of material that pertains to surgery and its intricate problems than this collection of papers.

J. A. Wolfer, M.D.

EVERY thinking medical man, in whatever branch of medicine or surgery he may have chosen his special training, must frequently be impressed with the fact that his knowledge is markedly limited on any subject. Invariably the final word is "resistance"; beyond that we know little. Ehrlich's side-chain theory of immunity in its widest interpretation is only a makeshift and takes us only a little farther into a deep mystery. Much as we may know about immunity to infectious diseases, the stability of the nervous system, the influences of heredity, yet there is a distinct barrier in the way to a clear and working conception of many of the problems confronting us today. Infection has been studied not only in the human and animal but in the laboratory with utmost perseverance and skill. Tumor formation is still in the category of ignorance. The clinician and research workers are ever striving to open new paths into the wilderness and jungles of medicine, that the penalties of life may be successfully coped with.

It is with much interest and reverence, therefore, that the recent work of Bandler[1] has been read and reread. The possibilities set forth in this volume are so far reaching and extensive that any review in detail is impossible. Endocrinology, although a comparatively new subject, has been talked and written about for years, without any great advance having been made. Unfortunately, this subject in the past has only too frequently been capitalized by the charlatan, and it requires such men as Bandler and others to take it out of the hands of the Philistines. This master student of life and its phenomena has certainly given us intellectual food as well as a possible explanation for many of the intricate problems of disease. If such is the case, we must rewrite much of our literature and we must change our methods of diagnosis and therapy to a considerable extent.

The author places before the reader his methods of deductions based on observations on the normal and abnormal, as regards the ductless glands. Many of the statements are decidedly radical, and for that reason will probably evoke antagonism in many who do not allow their minds an open sway, unbiased by previous opinions and prejudices. He gives a careful analysis of many of the peculiar mental disturbances and peculiarities which one encounters daily in the practice of medicine, especially those of the young adult female; then he proceeds to associate these with other phenomena which we know are due directly or indirectly to the ductless glands. The deductions on heredity are most interesting; after assaying to explain many of these phenomena on an endocrine basis, the author analyzes the ductless gland problem in a manner which is most convincing. One need only mention hyperthyroidism and cretinism in relation to the thyroid gland; acromegaly, giantism, dwarfism in relation to the pituitary gland; the processes coincident with puberty, menstruation, pregnancy and labor, as concerned with ovary, thyroid and pituitary gland, to arouse immediate and intense interest.

In conclusion a working basis is given, also details as to how to obtain a correct endocrine history and the therapeutic indication. This is illustrated by many case histories. As the author correctly states, every man has in his own practice an experimental laboratory so far as endocrinology is concerned.

Every practitioner of medicine should not only read this volume, but should study it with utmost care and deliberation. There is no doubt that within the next few years much progress will be made along those lines and the medical man who is ignorant on this subject will be decidedly handicapped in his work.

J. A. Wolfer, M.D.

TEXTBOOKS on general surgery are numerous, some very good, others of questionable value. It is exceedingly difficult to estimate the true value of any such work without asking oneself the question, What is this book intended for? The answer should be: To teach the principles of surgery to one who has learned the fundamental branches of medicine. It does not supplant extensive descriptive monographs. It is not designed to make specialists or surgeons of practitioners. It is simply to give the foundation for the study of surgery and must be supplemented by clinical teaching and by work in the experimental laboratory, operating room and pathological laboratory.

With this in view, the recent new work in surgery[2] is of interest. It is prepared by a group of men of no mean ability, all closely associated, thus giving more or less associated ideas. The general plan is the same as is found in practically all works of this

[1] The Endocrines. By Samuel Wyllis Bandler, A.B., M.D. Philadelphia and London: W. B. Saunders Company, 1920.

[2] Surgery. A Textbook by Various Authors. Edited by George E. Gask, C.M.G., D.S.O., F.R.C.S. Eng., and Hedley W. Wilson, M.S., M.B. Lond., F.R.C.S. Eng. Philadelphia: P. Blakiston's Son & Co., 1920.

class. Nevertheless one is impressed by a certain, what might be called, brief detail of the subjects. No time is lost by the authors to come directly to the point under discussion, the language is clear, and the subject matter unusually well handled.

The one point which stands foremost to the reviewer's mind is the most scientific and clear discussion of general surgical topics, viz., those topics which describe a general condition, such as inflammation, bone repair, bone infection, and many others. This to my mind marks a work of this type either as a success or a failure for teaching and self-instruction. No man can read the masterly description in the introduction to bone transplantation without at once understanding the whole subject of bone reaction. This is carried throughout the book and for this reason places the work far above the average textbook on surgery.

There are few subjects that pertain to surgery that are not mentioned if only in brief. Those topics which deserve elaboration are discussed more fully. Needless to say the thought is necessarily English and much that may be of interest to us, if only for the reason that it has been the result of American study, is omitted. Possibly this is for the better as the surgeon or student should be well grounded in general principles and not cling necessarily to strictly American methods and ideas. There are brief chapters on the diseases of the throat, nose, ear, and eyes, also on the female genitalia. This again may be open to question as there is no doubt that even the medical student must go farther than this brief résumé for his necessary knowledge on these subjects. It seems to the reviewer that this new work deserves decided praise.

Only as a constructive criticism it might be added that the publishers would do well to offer a better binding as in its present state this book would not withstand the average textbook usage.

J. A. Wolfer, M.D.

THE seventh edition of *Surgical Pathology* by Bowlby[1] and Andrewes is at hand. It is with no little satisfaction that this work has been reviewed in its present edition. It seems there is quite a deficiency in American medical literature on this subject. One is inclined to believe that too much emphasis is placed at the present day on surgical technique in the perfection of a surgeon. Technique is necessary and important but withal is not, to the reviewer's mind, the great and final attribute of a surgeon. The many institutes of surgical technique that have sprung up within the past years, should for this reason be cautioned and curtailed. Technique withal is comparatively simple and easily and readily learned in contrast to the recognition of pathological conditions. The latter tries the skill and ability of the operating surgeon. There is no doubt but that this discrepancy is directly responsible for much of the inferior surgery that is practiced at the present time.

The present edition has had chapters added in gas gangrene, shock and tetanus, also many new illustrations. Those chapters devoted to bone and joint pathology deserve especial attention, this subject being discussed in a masterly fashion in the greatest detail, in so far as it applies to surgical relief. The reviewer is rather disappointed in the brief description of gall-bladder and biliary pathology as that subject at present is certainly deserving of considerable attention. Withal the present edition fills a distinct place in medical literature, separate from ordinary texts on pathology and is especially desirable for the student of surgery. The final impression gained is that pathological changes must be seen and felt in order to be recognized.

J. A. Wolfer, M.D.

[1] Surgical Pathology and Morbid Anatomy. By Sir Anthony A. Bowlby, K.C.B., K.C.M.G., K.C.V.O., F.R.C.S., and Sir Frederick W. Andrewes, M.D., F.R.S. 7th ed. Philadelphia: P. Blakiston's Son & Co.

# AMERICAN COLLEGE OF SURGEONS

## THE NEW DEPARTMENT OF LITERARY RESEARCH OF THE AMERICAN COLLEGE OF SURGEONS

THE development of a Department of Literary Research as a new branch of the College's work of advancing the study of surgical problems is the realization of an idea which has been latent in the minds of some of the Founders since the beginning of the College. The most important features in the program of the new Department will be the making of extensive surveys, analyses, and statistical studies based on the work of the Fellows of the College. Through the Department, data on various groups of cases under the care of the Fellows during the preceding year will be collected, correlated, and analyzed from every possible standpoint. At certain stated intervals bulletins will be prepared, giving the results of these surveys arranged in the form of tables, charts, and maps, and accompanied by discussions of certain points which are emphasized, a review of the literature and a complete bibliography on that particular phase of the subject. The results of such surveys will be arranged in graphic form and in a manner which should appeal to both the profession and the laity for use at important meetings of the College, state and national.

Since the College includes in its membership nearly 5,000 surgeons of the United States, Canada and South America, such surveys and statistical researches should bring out many important facts not only as to symptomatology, diagnosis, treatment, and prognosis, but especially as to etiology, and the part played by variations in climate, by heredity, occupation, fatigue, diet, and many other factors in the causation of various conditions. Through such a research center the College should further "serve as an international force to keep before the profession of this hemisphere" a true conception of the great accomplishments and the shortcomings of surgery today. Such a Department will help the surgeon to see the results of American surgery in the large. It will, it is hoped, give an added impetus for research along the lines where the analyses show the possibilities of new theories which need the actual proof of laboratory research to remove them from the realm of empiricism. To stand as a connecting link between the surgeon and the research worker will be the main object of the Department, thus furthering the spirit of the new era of combined research in which, as Sir Berkeley Moynihan so well expresses it, "clinical observation, inductive and deductive processes of reasoning and experimental inquiry are linked together."

The need of such an undertaking is obvious. With the great advances which are continually taking place in medical science, and particularly in those phases related to surgery, the time of the surgeon is largely consumed in learning and making use of the new, approved methods in diagnosis and technique and in keeping in touch with the findings of the great research laboratories which may have a bearing on his particular field, by attending medical meetings and by reading the current medical literature. Only occasionally is it permitted to the average busy surgeon to assume the rôle of the philosopher and pause in the midst of his work to make extensive surveys and statistical studies on the various phases of the special subject in which he is most interested. When he does so, the survey is almost invariably confined to a review of the work of his own clinic or to a compilation of the cases recorded in surgical literature and, inasmuch as a man chooses for varying reasons the particular case which he publishes, a survey based on such a compilation can never be a true criterion of conditions as they actually exist.

While various individual surveys have been made from time to time by different societies, no organization has attempted a large series of systematic surveys, analyses, and statistical studies based on the current work of a large body of surgeons. Yet in what field is it more necessary to stop and survey things as they are, to analyze carefully the details of the work just passed, that one may have a clearer vision for the future? By carrying on such surveys and statistical studies, the College will be able to do for the Fellows collectively what each Fellow is unable to do for himself, and each Fellow through the College will be contributing to the progress

of science in a way that he could not possibly do alone.

It is earnestly hoped that each Fellow will feel that he has an active part to take in this new work. In order that the surveys may be complete and the bulletins prepared for distribution to the Fellows of the College, it will be necessary that each Fellow send in promptly the data requested. It will be a work by the Fellows of the College and for the Fellows of the College, and a means by which the Fellows, individually and collectively, will be furthering the great advances already taking place in American surgery. Absolutely no personal record will be kept of the statistical data, the entire purpose of the undertaking being the assembling of cases in the large and the analysis of such cases *en masse*.

Another phase of the work of the new Department will be the assistance of authors in the preparation of papers, monographs, and books on medical subjects. The Department will be glad to help Fellows in their medical literary work through the preparation of bibliographies, abstracts, and translations on any given subject related to general surgery or the surgical specialties, the compilation of such material, or any other editorial work which may be desired. For such literary research, the Department will have the use of the John Crerar Library, one of the most complete medical libraries in the country, until the College Library shall become the large reference library which we hope that it may in the future. A charge will be made for such assistance to cover the actual expense of the work.

## HOSPITAL STANDARDIZATION

THE hospital survey of the College for 1921 is nearing completion. The policy this year has been to pay particular attention to hospitals which either were not on the approved list last year or which appeared on the list with an asterisk. The asterisk on the approved list for 1920 indicated institutions which, when visited, did not fully meet the standard but which subsequently reported that the requirements of the minimum standard were fulfilled. The hospitals which were listed last year as being fully approved are not, as a general routine, being visited this year. Many additional hospitals having a capacity of between fifty to one hundred beds have been visited, so that by the end of this year the majority of these smaller institutions will have been surveyed.

It is gratifying to note that in most instances the institutions which appeared on the approved list with an asterisk last year have been found acceptable. Distinct improvement has been noted also in many of the institutions which did not appear on the approved list in 1920.

The work in the United States has been distributed among seven visitors, as follows: Dr. M. R. Broman in Western Texas, Arizona, California, Oregon, Washington, Utah, Idaho, Montana, and Colorado; Dr. B. R. Weston in Kentucky, West Virginia, Virginia, North Carolina, Tennessee, Missouri, Iowa, parts of Minnesota, and North and South Dakota; Dr. John G. Cheetham in southern Ohio, Maryland, Pennsylvania, and Chicago; Dr. C. T. Stephan in Oklahoma, Arkansas, Kansas, Western Missouri, Nebraska, Western Iowa, Minnesota, Michigan, northern Ohio, and New York state; Dr. B. W. Lowry in Texas, Louisiana, Alabama, Mississippi, Florida, Georgia, South Carolina, Delaware, New York City and Brooklyn, Connecticut, Rhode Island, Massachusetts, Maine, New Hampshire, and Vermont; Dr. L. D. Moorhead in Indiana and Illinois; Dr. J. L. Smith in Wisconsin.

### PROGRESS IN CANADA

Dr. T. R. Ponton, assistant superintendent of the Vancouver General Hospital, Vancouver, British Columbia, is making a survey of the Canadian hospitals for the American College of Surgeons. All general hospitals having a capacity of fifty or more beds are being visited. Dr. Ponton began his tour on May 22 and has already visited most of the Canadian hospitals. There are 154 general hospitals in Canada each having a capacity of over fifty beds; of these 89 have over one hundred beds and 65 have less than one hundred beds.

In 1920 there were 22 Canadian hospitals on the approved list of the College. From the preliminary reports already received, the report for 1921 in all probability will show a substantial increase.

The various provincial organizations have been active in improving hospital conditions. Indeed, as a result of their co-operation the program of hospital standardization has been markedly enhanced.

The Ontario Medical Association recently held its forty-first annual meeting in Niagara Falls. Dr. J. Heurner Mullin, in his presidential address, emphasized the need for an elaboration of the

hospitalization program, particularly with reference to the hospitals in the smaller communities. Dr. Mullin stated in part:

"Our hospital beds must be increased in number. Patients no longer find it convenient or possible to remain in their homes. The question of shortage of nursing aid, both fully trained or otherwise, or even domestic help, drive many to hospitals who would have preferred to have stayed at home. Many problems in careful diagnosis and treatment, whether medical or surgical, can be properly taken care of only in a well organized hospital.

"We must make provision to elaborate an extensive hospitalization program, which will take into consideration the actual needs in all of our small communities. It should be unnecessary for many of the patients and their friends to travel miles from home to some famous clinic, often at great expense and personal risk or injury. Each of these community hospitals should be thoroughly standardized according to a minimum plan.

"Those interested directly in the administration of such hospitals should not be satisfied until all members of the community where they are located will have the privilege of, and reason for, a complete confidence in the work conducted therein.

"A plan for hospital standardization has been developed which depends on the following features: (a) careful preparation and care of all scientific records; (b) complete laboratory service to assist in this; (c) careful study of such records by the group of medical men attending each institution.

"The study of these records, in an impersonal manner, will supply an abundance of clinical material not otherwise available. This plan of hospital standardization is no fairy story or fantastic dream, but is in actual operation in scores of institutions on this continent today. This does not seem much to ask when the interests of the public are vitally concerned.

"This community hospital becomes the health center of the district, the place of meeting for the local practitioners, a democratic and unselfish group clinic wherein we can continuously provide a system for the development of the general man along scientific lines."

Further, a clear cut attitude toward the practice of fee-division was expressed by Dr. Mullin:

"The buying and selling of patients, otherwise called fee-splitting, is another example of commercial enterprise and should be prevented by some amendment to the Criminal Code. The taking of any part of fees by any system of secret graft, without actual service rendered, and without the knowledge of the patient, should more properly be called 'theft.'

"If the specialist is not too busied with an egotistical appreciation of his own importance, he should recognize the part which the well trained general man takes in the community—services more valuable on critical occasions than any money can repay. The honest consultant should use every possible opportunity for assisting the public properly to understand the value of such services, and to pay a reasonable honorarium for the same. The real consultant should recognize his continuous duty in this education propaganda. In the future many of our now so-called special procedures will become routine with all general practitioners."

The hospital standardization committee of the Ontario Medical Association, with Dr. E. R. Secord as chairman, presented a report recommending certain hospital essentials dealing with staff organization, official action prohibiting the practice of fee-division, rules and regulations, monthly analytical staff meetings, case records, and laboratory facilities. Hence, the recommendations of the Ontario Medical Association are in close harmony with the minimum standard of the College, which is as follows:

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is "open" or "closed," nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff," and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, policies specifically provide:

   a. That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.)

   b. That the staff review and analyze at regular intervals the clinical experience of the staff in the

various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination, with clinical, pathological, and X-ray findings when indicated; the working diagnosis; the treatment, medical and surgical; the medical progress; the condition on discharge with final diagnosis; and, in case of death, the autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnoses, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluoroscopic service in charge of trained technicians.

In closing, Dr. Secord said:

"It would seem evident that these requirements are all in the best interests of the patient, which should be the first consideration in every hospital. It would seem that they are indeed the minimum requirements by which hospitals can best serve the sick of a community."

The committee further recommended that questionnaires be sent to all hospitals in the provinces, requesting information as to the process of staff selection and concerning the status of the hospitals with reference to the minimum standard.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

ELEVENTH ANNUAL SESSION, PHILADELPHIA, OCTOBER 24–28, 1921

GEORGE E. ARMSTRONG, Montreal, *President*
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## PHILADELPHIA AS A CLINICAL CENTER

BY GEORGE P. MULLER, M.D., PHILADELPHIA

IT is not in a spirit of boasting but with honest pride that Philadelphia looks upon itself as the center of clinical medicine in America. In this country, where everything is looked upon as being new, and institutions regarded as infantile in comparison with European institutions, we can with measurable pride look toward Philadelphia as the origin of medical education in America.

The first school of medicine to be founded in this country was in Philadelphia in 1765, when the present Medical School of the University of Pennsylvania was founded as a part of the "College Academy and Charitable School." Some years before this, in May, 1751, by act of the Provincial Assembly a law was passed "to encourage the establishment of a hospital for the relief of the sick poor of this province and for the reception and cure of lunaticks," and was approved by the Governor on the 11th of May, 1751. By this act a corporation was created by the name of "the Contributors of the Pennsylvania Hospital." This hospital is located on Spruce Street between Eighth and Ninth and some of the original buildings facing Pine Street are still intact.

In 1874 the University Hospital was founded to affiliate with the Medical School of the University of Pennsylvania, which was moved to its present site, and the original building still stands with its numerous additions.

The Philadelphia General Hospital was founded in 1732 as the Philadelphia Almshouse. Shortly thereafter a medical infirmary was added. This makes it probably the oldest hospital in the United States, being antedated only by the Hotel Dieu of Montreal and some Mexican hospitals. It was moved to its present site at Thirty-fourth and Pine Streets in 1832. In the early colonial days Benjamin Rush, William Shippen, John Morgan, and Thomas Bond were among its visiting physicians and since that time practically every name known to Philadelphia medicine was in some way or other connected with Blockley. It is estimated that approximately 56,000 medical students have received medical instruction at this hospital. The site at Tenth and Spruce streets, before its removal to the present site, was the supposed location of the final scene in Longfellow's *Evangeline*. In more recent years such names as Osler, Mitchell, Gross, Tyson, and Pepper have been connected with "Old Blockley" as it is affectionately called.

With a population of nearly two million, Philadelphia supports five medical schools: the Medical School of the University of Pennsylvania, Jefferson Medical College, the Woman's Medical College, Hahnemann Medical College, and the Medical School at Temple University. Until 1916 the Medico-Chirurgical College of Philadelphia existed as a separate institution, but in that year this school merged with the Univer-

sity of Pennsylvania for the establishment of the Medico-Chirurgical College and Hospital, Graduate School of Medicine of the University of Pennsylvania. In 1918 the Philadelphia Polyclinic and College for Graduates in Medicine also merged with the University and has since been known as the Polyclinic section of the Graduate School. This expansion in graduate medical instruction marked a new era for Philadelphia as a clinical center; for, while heretofore, graduate instruction had been given in Philadelphia it was not given in a systematic manner covering all the specialties in medicine and surgery. Thus, each year Philadelphia is able to send forth practitioners to wider duties, enriched by the experience of men with large clinical experiences covering many years of practice.

And so the work which had its foundation in the early part of the eighteenth century has grown and multiplied through the wisdom, forethought, courage, and energy of the early pioneers such as Benjamin Rush, John Physik, the elder Gross, Keen, Ashhurst, and Agnew.

It is hardly necessary to mention the great historical interest possessed by Philadelphia. The first Continental Congress met here in 1774 in Carpenter's Hall, and in Independence Hall at Seventh and Chestnut streets the Declaration of Independence was debated and signed and the United States Constitution adopted. The famous Liberty Bell is preserved here. These institutions are open for inspection, as are many other places of historical interest including the Betsy Ross House, Christ Church, Congress Hall, etc.

The suburban section around Philadelphia is beautifully developed and offers many miles of finely paved avenues for automobile touring. The famous watering place, Atlantic City, is connected by an almost straight concrete and asphalt road extending across the State of New Jersey.

## PLANS FOR THE PHILADELPHIA MEETING

A preliminary outline of the program for the evening sessions for the Philadelphia meeting, as arranged by the Executive Committee of the Clinical Congress, will be found in the following pages. The Congress formally opens with the presidential meeting on Monday evening in the Ballroom of the Bellevue-Stratford. On this occasion the distinguished foreign guests will be presented, and the President-elect, Dr. John B. Deaver, of Philadelphia, will deliver his inaugural address. Dr. William J. Mayo of Rochester will deliver the John B. Murphy Oration in Surgery. On Tuesday, Wednesday, and Thursday evenings papers dealing with surgical subjects of present-day importance will be read by a number of distinguished European and American surgeons.

Monday will be devoted to a series of conferences on matters relating to the hospital standardization program of the American College of Surgeons. These conferences will be held in the Ballroom of the Bellevue-Stratford beginning at 9 a.m. and 2 p.m. A complete program for these conferences will be published in the next issue of this journal.

The general plan of previous sessions will be followed — operative clinics and demonstrations in the hospitals and medical schools will occupy the morning and afternoon hours of the four days, Tuesday to Friday inclusive, with scientific meetings each evening in the ballroom at the Bellevue-Stratford.

A preliminary schedule of the clinics and demonstrations to be given by the clinicians of Philadelphia is presented in the following pages. This published schedule is a tentative one and will be amplified and corrected during the following weeks as the work of the Committee on Arrangements progresses, so that the final program will fully represent the clinical activities of that great medical center, providing a complete showing of its facilities in every department of surgery, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth, experimental surgery, surgical pathology, roentgenology, etc. The real program of the Congress, however, is that to be bulletined each afternoon at headquarters, which will present an accurate and detailed list of the operative clinics and demonstrations to be given in the several hospitals and medical schools on the succeeding day.

For the benefit of those especially interested in surgery of the eye, ear, nose, and throat, the Committee is arranging a series of special clinical demonstrations to be given each morning at 9 o'clock in one of the large rooms at the Bellevue-Stratford. Complete details with regard to this special feature will be published in the next issue of this journal.

### COLLEGE CONVOCATION

On Friday evening fellowship in the American College of Surgeons will be conferred upon a large group of American and Canadian surgeons at the ninth annual convocation of the College to be held in the ballroom. At the same time honorary

fellowships will be conferred upon the distinguished foreign guests.

An interesting and decidedly unique feature of the convocation will be the conferring of honorary fellowships in the Royal College of Surgeons of Ireland upon a group of distinguished American surgeons. Sir William I. de Courcy Wheeler, Vice-President, Sir Robert Hy Woods, past President, and Sir William Taylor, K.B.E., C.B., past President, representing the Irish College, will confer fellowships upon the following: George E. Brewer, George W. Crile, John M. T. Finney, Richard H. Harte, William W. Keen, Charles H. Mayo, William J. Mayo, Albert J. Ochsner.

### REDUCED RAILWAY FARES

The railways of the United States and Canada have, with but few exceptions, authorized the sale of round-trip tickets to Philadelphia on account of the Clinical Congress at one and one-half the ordinary one-way fare, provided that the journey be made by the same route both going to and returning from Philadelphia. Such special round trip tickets will be sold to members only upon presentation of identification certificates issued from the office of the Secretary-General. Identification certificates will be issued upon application to all who register. One certificate is good for the member and dependent members of his family. Under this special arrangement round-trip tickets will be sold from October 20 to 26 except in the far western states where the earliest selling date is October 19. The return limit is November 3, except in western states where the limit is November 4. Further detailed information with regard to fares and traffic arrangements will be published in the next issue of this journal.

### HEADQUARTERS

General headquarters for the Congress will be at the Bellevue-Stratford Hotel where the entire first floor has been reserved for the use of the Congress. The large ballroom will be utilized for the evening sessions, certain clinical demonstrations, business meetings, etc., while the Clover, Red, Green, and other large rooms and foyers on the same floor will provide ample space for registration and ticket bureaus, bulletin rooms, etc. Headquarters will be open for registration at noon, Monday, October 24th. The clinical program for Tuesday will be bulletined at headquarters that afternoon, and tickets for Tuesday's clinics will be issued as visiting surgeons register.

### PHILADELPHIA HOTELS

In addition to the Bellevue-Stratford, headquarters hotel, Philadelphia has a number of first-class hotels. In the immediate vicinity of the Bellevue-Stratford are the Adelphia, Ritz-Carlton, Walton, and St. James. A complete list of the hotels recommended by the local Committee on Arrangements is as follows:

Adelphia, 13th and Chestnut.
Aldine, 19th and Chestnut.
Belgravia, 1811 Chestnut.
Bellevue-Stratford, Broad and Walnut.
Blenheim, 17th and Chestnut.
Colonial, 11th and Spruce.
Colonnade, 15th and Chestnut.
Continental, 9th and Chestnut.
Dooners', 23 S. 10th.
Green's, 8th and Chestnut.
Hanover, 12th and Arch.
Longacre, 1431 Walnut.
Lorraine, Broad and Fairmount.
Rittenhouse, 22nd and Chestnut.
Ritz-Carlton, Broad and Walnut.
Royal Apartments, Broad and Girard.
St. James, 13th and Walnut.
Stenton, Broad and Spruce.
Vendig, 13th and Filbert.
Walton, Broad and Locust.
Windsor, 1217 Filbert.

### LIMITED ATTENDANCE — ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting the attendance, requiring registration in advance on the part of those who wish to attend. A survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools, as to their capacity for accommodating visitors, has been made and the limit of attendance based thereon.

This plan insures accommodations at the clinics for all who register in advance, and the necessity for adopting such a plan will be apparent to all. Based upon our experience at previous meetings, it is probable that the limit of attendance will be reached weeks in advance of the meeting. When the limit of attendance has been reached through advance registration, no further applications can be accepted.

### CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, the number of tickets issued for any clinic or demonstration being limited to the capacity of the room in which the clinic or demonstration is to be given.

Clinic tickets will be issued at headquarters each morning at 8 o'clock for the clinics and demonstrations to be given that day, except that for Tuesday's clinics the tickets will be

issued on Monday as the visiting surgeons register. Each afternoon a complete schedule of the following day's clinics will be posted on bulletin boards at headquarters. After the program has been posted, reservations for tickets for the clinics may be filed, the tickets to be issued the following morning. Printed programs will be issued each morning.

REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, the receipts from registration fees providing the funds with which to meet the expenses of conducting the meeting, so that no financial burden is imposed upon the members of the profession in the city entertaining the Congress.

A formal receipt for the registration fee is issued to each surgeon registering in advance, which receipt is to be exchanged for a general admission card at headquarters upon his arrival in Philadelphia. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings.

*Preliminary program of evening sessions and schedule of clinics and demonstrations will be found on the following pages.*

## PROGRAM FOR EVENING MEETINGS

In the Ballroom of the Bellevue-Stratford Hotel, at 8 p.m.

*Presidential Meeting, Monday, October 24*

Address of Welcome: George P. Muller, M.D., Philadelphia, Chairman, Committee on Arrangements.

Address of the retiring President: George E. Armstrong, M.D., Montreal.

Introduction of foreign guests: Sir Harold J. Stiles, K.B.E., Edinburgh; Sir William Taylor, K.B.E., C.B., Dublin; Sir William I. de Courcy Wheeler, F.R.C.S.I., Dublin; Sir Robert Hy Woods, F.R.C.S.I., Dublin; Professor H. C. Jacobaeus, Stockholm; J. Schoemaker, M.D., The Hague; Professor F. de Quervain, Berne.

Inaugural Address: John B. Deaver, M.D., Philadelphia.

Sir William I. de Courcy Wheeler, F.R.C.S.I., Dublin: Random Thoughts on Surgical Topics.

The John B. Murphy Oration on Surgery: William J. Mayo, M.D., Rochester, Minnesota.

*Tuesday, October 25*

Symposium: Sarcoma of the Long Bones.

Joseph C. Bloodgood, M.D., Baltimore: Diagnosis and Pathology (illustrated).

William B. Coley, M.D., New York: Conservative Treatment.

Ernest A. Codman, M.D., Boston: Pathologic Fractures.

Henry W. Meyerding, M.D., Rochester, Minn.: A Study of Microscopically Proven Cases and End Results.

Discussion: A. P. C. Ashhurst, M.D., Philadelphia; Frederic A. Besley, M.D., Chicago.

Sir Harold J. Stiles, K.B.E., Edinburgh: Neuritis Due to Pressure of First Rib upon Brachial Portion of First Thoracic Nerve.

Professor H. C. Jacobaeus, Stockholm: Thoracopy and Its Practical Importance for Surgery of the Chest.

*Wednesday, October 26*

Symposium: Reconstruction Surgery.

Allen B. Kanavel, M.D., Chicago: Reconstruction Surgery of the Hand

Vilray P. Blair, M.D., St. Louis: Reconstruction Surgery of the Face.

Nathaniel Allison, M.D., St. Louis: Surgery of Impaired Joint Function.

Discussion: Robert H. Ivy, M.D., Philadelphia; A. Bruce Gill, M.D., Philadelphia.

J. Schoemaker, M.D., The Hague, Holland: Some Technical Points in Abdominal Surgery.

Symposium: Gynecology and Obstetrics.

Thomas S. Cullen, M.B., Baltimore: Abdominal Surgery.

John Osborn Polak, M.D., Brooklyn: The Present Status of Operative Obstetrics, Referring to the Abuse of Cæsarean Section.

Discussion: Brooke M. Anspach, M.D., Philadelphia; Edward P. Davis, M.D., Philadelphia. Barton Cooke Hirst, M.D., Philadelphia.

*Thursday, October 27*

Symposium: Gall-Bladder Surgery.

Harry M. Richter, M.D., Chicago: Gall-Bladder Surgery, with Special Reference to Closure of the Abdomen without Drainage.

George W. Crile, M.D., Cleveland: The Technique of Gall-Bladder Surgery in the Presence of Jaundice.

Discussion: Achille M. Willis, M.D., Richmond; George P. Muller, M.D., Philadelphia; John T. Bottomley, M.D., Boston; E. W. Archibald, M.D., Montreal.

Professor F. de Quervain, Berne, Switzerland: Relation Between the Histological Aspect and the Clinical and Epidemiological Peculiarities of Goiter.

Symposium: Nerve Suture.

Dean Lewis, M.D., Chicago: End Results.

Discussion: Charles H. Frazier, M.D., Philadelphia; G. Carl Huber, M.D., Ann Arbor.

*Convocation of the American College of Surgeons, Friday, October 28*

Invocation: D. Cardinal Dougherty, Archbishop of Philadelphia.
Conferring of Honorary Fellowships.
Presentation of Candidates for Fellowship.
Presidential Address: John B. Deaver, M.D., Philadelphia.
Fellowship Address: Sir Harold J. Stiles, K.B.E., Edinburgh.

The following distinguished South American surgeons are also expected to attend the Clinical Congress: Dr. Marcelino Herrera Vegas, Buenos Aires, Argentina; Dr. Claudio Sanjines, LaPaz, Bolivia; Dr. J. Alves de Lima, São Paulo, and Dr. José Mendonça, Rio de Janeiro, Brazil; Surgeon General Alberto Adriasola, Valparaiso: Dr. Gregorio Amunategui and Dr. Lucas Sierra, Santiago, Chile; Dr. Miguel H. Alcivar, Guayaquil, Ecuador; Dr. Guillermo Gastañeta and Dr. Francisco Graña, Lima, Peru; Dr. Enrique Pouey, Montevideo, Uruguay.

## PRELIMINARY CLINICAL PROGRAM

### PHILADELPHIA GENERAL HOSPITAL

*Tuesday, October 25*

H. W. Loux—9. General surgery.
J. T. Rugh—11. Orthopedics.
M. M. Franklin—3:30. Orthopedics.

*Wednesday, October 26*

T. T. Thomas—9. General surgery.
E. R. Kirby—12. Genito-urinary surgery.
E. B. Krumbhaar—2. Exhibition of radium plant.
F. O. Lewis 3:30. Laryngology.

*Thursday, October 27*

John Fisher—9. Gynecology.
J. C. Hirst—10:30. Gynecology.

*Friday, October 28*

H. R. Owen—9. General surgery.
R. H. Ivy—11:30. Oral surgery.

### POLYCLINIC HOSPITAL

*Tuesday, October 25*

Def. P. Willard—9. Orthopedics.
T. B. Holloway—2. Ophthalmology.
R. Butler—2. Nose and throat clinic.

*Wednesday, October 26*

J. K. Young—9. Orthopedics.
L. C. Peter—2. Ophthalmology.
C. B. Gleason—2. Otology.

*Thursday, October 27*

W. C. Elmer—9. Orthopedics.
C. F. Martin—11. Proctology.

*Friday, October 28*

J. B. Roberts—9. Plastic surgery.
B. A. Thomas—2. Urology.
G. B. Wood—2. Tonsil clinic.

### PRESBYTERIAN HOSPITAL

*Tuesday, October 25*

J. H. Jopson and D. B. Pfeiffer—9. General surgery.
A. B. Gill—12. Orthopedics.
J. H. Girvin—2. Gynecology.
Ralph Pemberton—2. Present status of pathology and treatment of arthritis, with exhibition of patients.
Ralph Pemberton, B. A. Thomas, N. P. Stauffer, J. E. Aiguier and assistants—2:45. Brief analysis of incidence of various types of focal infection in one hundred consecutive admissions to the medical service.
A. B. Gill—3. Treatment of tuberculous arthritis (exhibition of patients).
J. H. Jopson—3:30. Discussion of fractures into joints.
H. P. Brown—4. Results of Willems' treatment.

*Wednesday, October 26*

G. E. Shoemaker—9. Gynecology.
B. A. Thomas—2. Urology.

*Thursday, October 27*

John Speese, J. S. Rodman and H. P. Brown—9. General surgery.

*Friday, October 28*

J. H. Jopson and D. B. Pfeiffer—9. General surgery.
N. P. Stauffer—2. Nose and throat.

### CHILDREN'S HOSPITAL (MARY J. DREXEL HOME)

*Wednesday, October 26*

Ralph Butler—8. Mastoid operations.
N. L. Knipe—2. Ophthalmology.

*Friday, October 29*

H. C. Deaver and E. G. Alexander—10:30. General surgery.

## UNIVERSITY HOSPITAL

*Tuesday, October 25*

B. C. Hirst, E. B. Piper, and J. C. Hirst, 2nd—9. Obstetrics and gynecology.
George G. Ross—9. Hernia operations.
F. E. Keene and Charles C. Norris—9. Gynecology.
J. B. Carnett—11. General surgery.
E. L. Eliason—12. General surgery.
A. B. Gill—10. Orthopedics.
B. C. Hirst, E. B. Piper, J. C. Hirst, 2nd., and C. C. Wolferth—2. Obstetrical and gynecological complications; cardiac conditions complicating pregnancy.
J. E. Sweet—2. Experimental surgery.
A. B. Gill—2. Orthopedics.
Charles H. Frazier—3:30. Surgery of the nervous system.

*Wednesday, October 26*

Charles H. Frazier and Francis Grant—9:30. Surgery of the nervous system (operations).
F. E. Keene and Charles C. Norris—9. Gynecology.
D. B. Pfeiffer—9. General surgery.
Thomas R. Neilson and Alex Randall—11. Urology.
George P. Muller and H. K. Pancoast—2. Malignant disease of the face and mouth.
F. E. Keene and Charles C. Norris—2. Gynecological demonstration.
J. E. Sweet—2. Experimental surgery.
H. K. Pancoast—3. Roentgenology.
D. B. Pfeiffer—3. Rectal carcinoma.
T. T. Thomas—3:30. Shoulder dislocations.
J. B. Carnett and E. L. Eliason—4. Demonstrations of a fracture.

*Thursday, October 27*

B. C. Hirst, E. B. Piper, J. C. Hirst, 2nd—9. Gynecology and obstetrics.
F. E. Keene and Charles C. Norris—9. Gynecology.
George P. Muller—9. Surgery of the chest.
C. H. Frazier and Francis Grant—9:30. Neurological surgery.
A. B. Gill—10. Orthopedics.
T. T. Thomas—11. General surgery.

*Friday, October 28*

F. E. Keene and Charles C. Norris—9. Gynecology.
A. C. Wood—9. General surgery.
C. H. Frazier and Francis Grant—9:30. Surgery of the nervous system and goiter.
John B. Deaver—10:30. General surgery.
J. E. Sweet—2. Experimental surgery.
Charles L. Grayson—2. Otolaryngology.
Charles H. Frazier and Francis Grant—2. Surgery of the nervous system and goiter.
H. K. Pancoast—3. Roentgenology.
Drs. Deaver, Wood, Ross, Muller, Carnett, Eliason, Pfeiffer, Stengel, Pepper, Fox, Richards, Miller, Wolferth, Kern—3. Joint clinic on medical aspect of surgical cases and vice versa.

## ORTHOPEDIC HOSPITAL

*Tuesday, October 25*

A. Bruce Gill—9. Orthopedics.
William J. Taylor—11. Orthopedics.
A. P. C. Ashhurst and Edward T. Crossan—2. Demonstration: tarsectomy for rigid flat foot, inveterate club foot, and equinovarus; birth injuries of shoulders; lacerations of brachial plexus.

## PENNSYLVANIA HOSPITAL

*Tuesday, October 25*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
Drs. LeConte, Lee, and Brown—11. General surgery.
L. J. Herman—1. Genito-urinary surgery.
E. A. Strecker—1. Neurology.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
Drs. Shoemaker and Crampton—2. Eye clinic.

*Wednesday, October 26*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
G. W. Norris—10. Medical clinic.
Drs. Gibbon, Billings, and Klopp—11. General surgery.
Drs. Shoemaker and Crampton—2. Eye clinic.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
F. C. Knowles—2. Skin.

*Thursday, October 27*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
A. Newlin—10. Medical clinic.
Drs. Mitchell, Lee, and Brown—11. General surgery.
L. J. Herman—1. Genito-urinary surgery.
Drs. Newcomer, Davis, and Knowles—2. Syphilis: Salvarsan.
E. A. Strecker—2. Neurology.
Drs. Shoemaker and Crampton—2. Eye clinic.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.

*Friday, October 28*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
Dr. Newcomer—10. Surgical pathology.
D. R. Bowen—10. Roentgenology.
T. McCrae—10. Medical clinic.
Drs. Gibbon, Billings, and Klopp—11. General surgery.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
Drs. Shoemaker and Crampton—2. Eye clinic.

## JEFFERSON HOSPITAL

*Tuesday, October 25*

J. T. Rugh—9. Orthopedics.
E. P. Davis—10. Obstetrics.

*Wednesday, October 26*

Brooke M. Anspach—9. Gynecology.
J. Chalmers DaCosta—2. General surgery.

*Thursday, October 27*

H. R. Loux—10. Urology.
Chevalier Jackson—2. Bronchoscopy.

*Friday, October 28*

John H. Gibbon—10. General surgery.
S. MacCuen Smith—2. Otology.
Willis F. Manges—2. Roentgenology.

## MEDICO-CHIRURGICAL HOSPITAL

*Tuesday, October 25*

GEORGE P. MULLER and staff—9. Surgical clinic operations and demonstrations.
J. A. KOLMER and E. A. CASE—9:30. Demonstration—frozen section work.
E. A. MCKNIGHT—2. Demonstration—fractures of the forearm.
R. H. SKILLERN—2. Sinus clinic.
R. F. RIDPATH—2. Tonsil clinic.
WILLIAM BATES—2:15. Demonstration—fractures of the tibia and fibula.
B. R. BELTRAN—2:30. Demonstration—fractures of the femur.
I. S. RAVDIN—2:45. Demonstration—postoperative cases of compound fracture.
T. T. THOMAS—3:00. Recurrent dislocation of the hip and shoulder. Demonstration of cases and anatomical specimens.
L. W. FOX—3. Ophthalmic clinic.
JOHN H. JOPSON—3:30. Demonstration—fractures of the carpal and tarsal bones.
GEORGE P. MULLER—3:45. Demonstration—fractures of the skull.
ROBERT H. IVY—4. Demonstration—fractures of the mandible.

*Wednesday, October 26*

JOHN H. JOPSON—9. Surgical clinic.
WILLIAM R. NICHOLSON and staff—9. Gynecology.
GEORGE W. OUTERBRIDGE—2. Demonstration—cystoscopy.
G. M. COATES—2. Tonsil clinic.
M. ERSNER—2. Tonsil clinic.
T. F. JAFFE—2:15. Demonstration—gynecological models.
WILLIAM R. NICHOLSON—2:30. Demonstration—postoperative gynecological cases.
DEFORREST P. WILLARD—2:45. Demonstration—cases of hip joint disease.
WALTER G. ELMER—3. Demonstration—cases of Potts' disease.
JAMES M. ANDERS—3:15. Demonstration—cases of aneurism.
GEORGE M. PIERSOL and staff—3:30. Demonstration of cases for gastro-enterologic study.
MRS. M. S. STEELE—3:45. Speech clinic.
MISS H. E. KIRSH—4. Surgical social service.

*Thursday, October 27*

ERNEST LAPLACE and staff—9. Surgical clinic and demonstrations.
GEORGE M. BOYD and staff—9. Gynecological clinic.

*Friday, October 28*

J. B. CARNETT—9. Surgical clinic.
M. B. MILLER—9. Surgical clinic.
GEORGE E. PFAHLER—2. Electro-coagulation clinic with demonstration of cases.
DRS. SKILLERN, RIDPATH, COATES and ERSNER—2. Nose and throat clinic.
L. W. FOX—2. Ophthalmic clinic.
ROBERT H. IVY—3. Demonstration—postoperative results in maxillofacial surgery.
M. B. MILLER—3:15. Demonstration of cases of cervical-adenitis treated with tuberculin.
J. STEWART RODMAN—3:30. Demonstration—neurological surgery.
P. G. SKILLERN—3:40. Demonstration—new method in operative technique.

## LANKENAU HOSPITAL

*Tuesday, October 25*

R. BUTLER and J. A. BABBITT—2. Otolaryngology.
W. T. SHOEMAKER and E. A. SHUMWAY—2. Ophthalmology.
MISS JASTROW—2. Follow-up system.
W. H. MACKINNEY—3. Urology.
S. P. REIMANN—3. Clinical laboratory methods.
A. G. MILLER and R. SHOEMAKER, 3rd—3. Roentgenology: fractures and joint injuries.

*Wednesday, October 26*

J. B. DEAVER, G. G. ROSS, and A. D. WHITING—9. General surgery.
MISS JASTROW—2. Follow-up system.
R. BUTLER and J. A. BABBITT—3. Otolaryngology.
W. T. SHOEMAKER and E. A. SHUMWAY—3. Ophthalmology.

*Thursday, October 27*

J. B. DEAVER, G. G. ROSS and A. D. WHITING—9. General surgery.

*Friday, October 28*

S. P. REIMANN—2. Pathological demonstrations.
A. G. MILLER and R. SHOEMAKER, 3rd—2. Roentgenology: fractures and joint injuries.
W. H. MACKINNEY—3. Urology

## METHODIST HOSPITAL

*Tuesday, October 25*

WILLIAM R. NICHOLSON—9. Gynecology.
J. H. BALDWIN—11. General surgery.
M. F. PERCIVAL—11. Roentgenology.
WALTER ROBERTS—2. Nose and throat.
PHILIP H. MOORE—2. Ophthalmology.

*Wednesday, October 26*

G. G. ROSS—9. General surgery.
RICHARD NORRIS—11. Gynecology and obstetrics.

*Friday, October 28*

J. T. RUGH—9. Orthopedics.
J. L. HERMAN—11. Genito-urinary surgery.
L. J. HAMMOND—2. General surgery.

## HOWARD HOSPITAL

*Tuesday, October 25*

A. C. WOOD—9. General surgery.
E. L. ELIASON—11. General surgery.
GEORGE B. WOOD—2. Nose and throat.
R. J. HUNTER and S. COHEN—3. Nose and throat operations.

*Wednesday, October 26*

BERNARD MANN—9. Gynecology.
BARTON COOKE HIRST—11. Gynecology.
W. C. POSEY—2. Eye clinic.

*Thursday, October 27*

A. C. WOOD—9. General surgery.
E. L. ELIASON—11. General surgery.
GEORGE B. WOOD—2. Nose and throat.

*Friday, October 28*

BERNARD MANN—9. Gynecology.
BARTON COOKE HIRST—11. Gynecology.
W. C. POSEY—2. Eye clinic.

## ST. AGNES' HOSPITAL

*Tuesday, October 25*

G. M. Dorrance and staff—9. General surgery.
J. M. Fisher—9. Repair of pelvic floor; amputation of cervix; hysterectomy for fibroids of the uterus; hysterectomy for carcinoma of the uterus; operative correction for displacements of the uterus; operations in cases of pelvic inflammatory diseases.
G. M. Dorrance and L. E. McCrea—11. Plastic operations on the face and neck with cases showing results of operations.
B. D. Parrish—2. Demonstration of sinus cases with tonsillectomy by the LaForce method, local and general anæsthesia.

*Wednesday, October 26*

J. F. X. Jones and staff—9. General surgery.
John V. McGlinn—9. Gynecology.
W. J. Ryan—11. Demonstration of results in treatment of fractures.
J. P. Mann—2. Demonstration of cases with operation for diseases of the hip joint.

*Thursday, October 27*

G. M. Dorrance—9. General surgery.
J. C. Hirst—9. Clinic on prolapse of the uterus.
J. W. Bransfield—11. Treatment of burns by use of acetic acid method.
E. C. Murphy—11:30. Application of plaster cast in fracture of neck of femur.

*Friday, October 28*

J. F. X. Jones and staff—9. General surgery.
Alfred Heineberg—9. Uterine endoscopy.
J. F. X. Jones and W. J. Ryan—2. Demonstration of results of hernia operations.
B. D. Parrish—2. Demonstration of mastoid cases with indications for each.

## WOMAN'S MEDICAL COLLEGE

*Tuesday, October 25*

Alice W. Fallant—9. Obstetrics.
E. G. Alexander—10. General surgery.
H. C. Deaver—11. General surgery.

*Wednesday, October 26*

Ella B. Everitt—9. Gynecology.
Margaret Butler—2. Rhinology.
Mary Buchanan—3. Ophthalmology.

*Thursday, October 27*

Ella B. Everitt—9. Gynecology.

## AMERICAN HOSPITAL FOR DISEASES OF THE STOMACH

*Thursday, October 27*

W. Wayne Babcock—10. Gastric surgery.
Lewis Brinton—11. Clinical demonstrations of gastro-intestinal diseases.

*Friday, October 28*

J. B. Carnett—9. General surgery.
Frank White—10. General surgery.
J. C. Hirst—11. Gynecology.

## PROTESTANT EPISCOPAL HOSPITAL

*Tuesday, October 25*

A. P. C. Ashhurst and I. M. Boykin—9. General surgery.
Louis H. Mutschler—11. General surgery.
G. Oram Ring—3. Ophthalmology.

*Wednesday, October 26*

A. Bruce Gill—9. Orthopedic operations.
H. G. Goldberg—2. Ophthalmology. Cataract cases.
J. P. Gallagher and E. Collins—3. Ear, nose and throat. Ethmoid cases.

*Thursday, October 27*

H. C. Deaver and E. G. Alexander—9. General surgery.
T. R. Neilson—11. General surgery.
Charles C. Biedert and T. R. Currie—2. Ear, nose and throat operations.

*Friday, October 28*

A. P. C. Ashhurst and Edward T. Crossan—9. Genera surgery.
A. P. C. Ashhurst and Ralph S. Bromer—2. Dry bone clinic: cystic disease and sarcoma.

## MOUNT SINAI HOSPITAL

*Tuesday, October 25*

J. C. Hirst—9. Gynecology.
George Rosenbaum—11. X-ray demonstrations.
A. Watson—2. Nose and throat operations.
C. W. LeFever—4. Eye operations.

*Wednesday, October 26*

M. Behrend—9. General surgery.
L. Fisher—2. Nose and throat operations.
A. I. Rubenstone—2. Surgical pathology and blood transfusion.
C. S. Hirsch—4. Genito-urinary surgery.

*Thursday, October 27*

L. Brinkman—9. Gynecology.
George Rosenbaum—11. X-ray demonstrations.

*Friday, October 28*

J. C. Hirst—9. Gynecology.
M. Behrend—11. General surgery.
L. Fisher—2. Nose and throat operations.
S. J. Gittelson—3. Eye operations.
A. I. Rubenstone—4. Surgical pathology and blood transfusion.

## ST. CHRISTOPHER'S HOSPITAL

*Tuesday, October 25*

Frederick Krauss—2. Mastoid clinic.
R. R. Willoughby—4. Tonsil and adenoid operations.

*Wednesday, October 26*

Robert Gray—9. Orthopedic operations.
E. G. Alexander—11. General surgery.

*Thursday, October 27*

C. V. Curkendall—9:30. Tonsil and adenoid operations.
Dr. Adams—2. Operative eye clinic.

## HAHNEMANN HOSPITAL

*Tuesday, October 25*

H. L. NORTHROP—9. General surgery.
N. F. LANE and W. D. CULIN—9. Gynecology.
F. H. WIDMAN—2. Demonstration of the electrocardiograph.
C. BARTLEIT—2:30. Relation of electrocardiograph to operative surgery.
W. G. SCHMIDT—2:45. Hydrogen-ion concentration.
G. H. WELLS—3:15. Acidosis.
J. S. HEPBURN—3:30. Blood chemistry.
W. R. WILLIAMS—4. Application of blood chemistry to clinical surgery.

*Wednesday, October 26*

G. A. VAN LENNEP—9. General surgery.
J. E. JAMES, JR.—9. Prenatal care.
J. D. ELLIOTT—2. Treatment of cancer with the knife and Coley's fluid.
H. L. NORTHROP—2:30. Treatment of cancer with electrothermic cautery.
F. C. BENSON—3. Treatment of cancer with radium.
J. W. FRANK—3:30. Treatment of cancer with X-rays; presentation of cases.

*Thursday, October 27*

H. P. LEOPOLD—9. General surgery.
D. B. JAMES—9. Gynecology.

*Friday, October 28*

L. T. ASHCRAFT—9. Urology.
W. C. MERCER—9. Obstetrics.
F. J. FROSCH—2. Physiology and pathology of the endometrium.
S. W. SAPPINGTON—3. Basal metabolism, with demonstrations and technique.
J. D. ELLIOTT—3:30. Tumors of the breast.
J. A. BROOKE—4. Acute infectious arthritis.

## STETSON HOSPITAL

*Tuesday, October 25*

B. M. ANSPACH—9. Gynecology.
W. K. NEELY—2. Obstetrics.

*Wednesday, October 26*

S. E. TRACY—9. Gynecology. Sterilization and operating room technique.
CARL LEE FELT—2. Laryngology.

*Thursday, October 27*

J. A. BOGER and W. T. ELLIS—9. General surgery.

*Friday, October 28*

S. E. TRACY—9. Gynecology. Sterilization and operating room technique.
CARL LEE FELT—2. Laryngology.

## KENSINGTON HOSPITAL FOR WOMEN

*Wednesday, October 26*

E. G. ALEXANDER—9. Gynecology.
H. C. DEAVER—11. Gynecology.

*Friday, October 28*

DANIEL LONGAKER—9. Obstetrics.
W. E. PARKE—11. Gynecology.

## MISERICORDIA HOSPITAL

*Tuesday, October 25*

JAMES A. KELLY—9. General surgery.
ERNEST LAPLACE—9. General surgery.
CORNELIUS MCCARTHY—2. Nose and throat.

*Wednesday, October 26*

J. F. X. JONES—9. General surgery.
GEORGE P. MULLER—9. General surgery.
THOMAS F. BYRNE—2. Nose and throat.

*Thursday, October 27*

JAMES A. KELLY—9. General surgery.
ERNEST LAPLACE—9. General surgery.

*Friday, October 28*

J. F. X. JONES—9. General surgery.
GEORGE P. MULLER—9. General surgery.
LOUIS LOVE—2. Ophthalmology.

## ST. JOSEPH'S HOSPITAL

*Tuesday, October 25*

JOSEPH M. SPELLISY—9. Orthopedics.
JOHN F. X. JONES—10:30. General surgery.
GEORGE MORLEY MARSHALL and WILLIAM E. QUICKSALL—2. Otology and laryngology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—2. Ophthalmology.

*Wednesday, October 26*

JAMES A. KELLY—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—11. Gynecology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—2. Ophthalmology.

*Thursday, October 27*

MELVIN M. FRANKLIN—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—10:30. Gynecology.

*Friday, October 28*

CHARLES F. NASSAU—9. General surgery.
E. E. MONTGOMERY, F. HURST MAIER, and P. BROOKE BLAND—11. Gynecology.
GEORGE MORLEY MARSHALL and WILLIAM E. QUICKSALL—2. Otology and laryngology.
PAUL J. PONTIUS, CHARLES J. JONES, and T. A. O'BRIEN—2. Ophthalmology.

## WOMEN'S HOMEOPATHIC HOSPITAL

*Tuesday, October 25*

DRS. W. E. STRONG, ROCHESTER and HARTLEY 9. General surgery.
DRS. PALEN, CLAY and CRISWELL—2. Eye, ear, nose and throat.

*Wednesday, October 26*

L. T. ASHCRAFT—9. Urology.
W. C. BARKER—2. Roentgenology.

*Friday, October 28*

DRS. BROOKE and LARER—9. Orthopedics.
DRS. CALEY, HUGHES and D. B. JAMES, JR.—10:30. Gynecology.
J. A. BROOKE—2. Obstetrics.

## SAMARITAN HOSPITAL

*Tuesday, October 25*

H. Hudson—9. Orthopedics.
William A. Steel—10. General surgery.
Wilmer Krusen—12. Gynecology.
Luther C. Peter—2. Ophthalmology.
William A. Hitschler—3. Rhino-laryngology.
J. H. Clark and Eugene Asnis—4. Clinical pathology.

*Wednesday, October 26*

J. O. Bower—9. Malignant disease.
W. Wayne Babcock—10. General surgery.
Collier F. Martin—12. Rectal surgery.
William E. Robertson—2. Basal metabolism.

*Thursday, October 27*

G. C. Bird—9. X-ray diagnosis.
W. Hersey Thomas—10. Urology.
J. O. Arnold—11. Obstetrics.
Frank Hammond—12. Gynecology.

*Friday, October 28*

William E. Robertson—9. Electrocardiogram.
W. Wayne Babcock—10. General surgery.
Wilmer Krusen—12. Gynecology.
Edwin Mitchell—2. Laryngology.
Henry J. Off—3. Otology.
H. Booker Mills—4. Pediatrics.

## WOMAN'S HOSPITAL

*Tuesday, October 25*

Mary Thomas Miller—9. Obstetrics.
Lydia Stewart Coghill—10. Obstetrics.
Ella Williams Grim—11. Obstetrics.
Ann Tomkins Gibson—12. Obstetrics.
Laura Emma Hunt—2. Nose, throat and ear.

*Wednesday, October 26*

Catherine MacFarlane—9. Gynecology.
Caroline M. Purnell—11. Gynecology.
Margaret Warlow—2. Nose, throat and ear.
Mary Gettys—Eye.

*Thursday, October 27*

Marie K. Formad—9. Gynecology.
Sarah H. Lockrey—11. Gynecology.

*Friday, October 28*

Kate W. Baldwin—9. Spectro-chrome therapy or attuned color waves as an adjunct to general surgical work.

## JEWISH HOSPITAL

*Tuesday, October 25*

W. H. Teller—9. General surgery.
C. S. Hirsch—9. Urology.
E. Steinfield—10. Serology and bacteriology.
H. M. Goddard—2. Rhinology.
S. L. Feldstein—2. Roentgenology.

*Wednesday, October 26*

F. B. Block—9. Pelvic surgery.
A. Reiss—12. Electrotherapy.
S. F. Feldstein—2. Roentgenology.
C. Stamm—2. Obstetrics.
A. W. Watson—3. Rhinology.

*Thursday, October 27*

M. Behrend—9. General surgery.
E. Steinfield—10. Serology and bateriology.

*Friday, October 28*

C. S. Hirsch—9. Cystoscopy and urology.
L. Brinkman—10. General surgery.
S. L. Feldstein—2. Roentgenology.
G. W. Sholler—2.30. Gyneoclogy.

## CHILDREN'S HOMEOPATHIC HOSPITAL

*Tuesday, October 25*

H. P. Leopold—11. General surgery.

*Wednesday, October 26*

Bayard Knerr—11. Nose and throat.
F. W. Smith, Oscar Seeley, and O. F. Barthmaier—2. Pathological studies.

*Thursday, October 27*

John A. Brooke—2. Orthopedics.

## ST. LUKE'S HOSPITAL

*Tuesday, October 25*

Desiderio Roman—9. General surgery.
O. F. Barthmaier and J. W. Post—2. Group study of the thyroid; laboratory, roentgenology, surgery.

*Friday, October 28*

Desiderio Roman—9. General surgery.
I. G. Shallcross—11. Eye clinic.
J. W. Post—2. Roentgenological study of chronic arthritis as a basis for differential diagnosis and etiology.

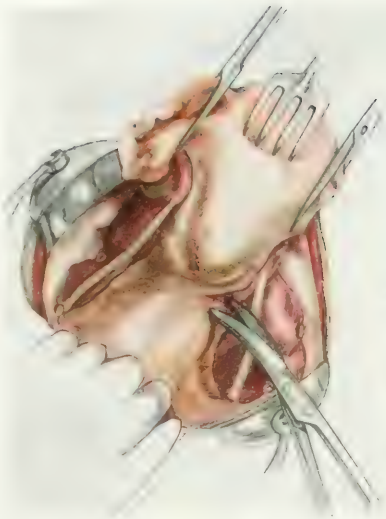

Fig. 1. First step in operation, separation of rectum from the vagina. The uterus is drawn forward and the rectum with its peritoneal covering is pulled backward. The ureter on either side is separated from the posterior layer of the broad ligament. The uterine and spermatic vessels have already been tied and the broad ligaments divided.

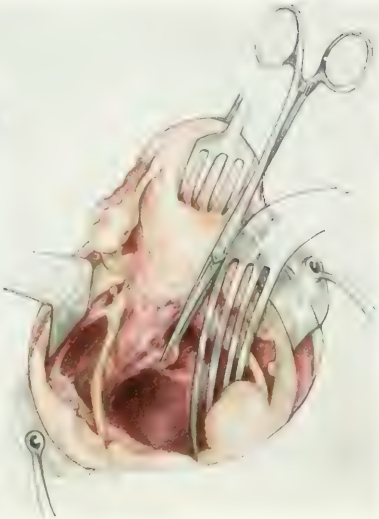

Fig. 2. Exposing the cervicopelvic ligament. The left ureter and the rectum are held aside by the Takayama rectum retractor. The uterosacral ligament has been removed and pulled forward with long pressure forceps.

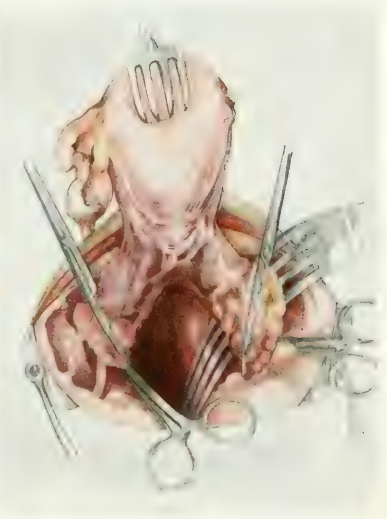

Fig. 3. The cervicopelvic ligaments have been divided and are held back with long forceps. The uterus is drawn forward and the rectum has been pulled aside by means of the rectum retractor.

*Radical Abdominal Hysterectomy for Cancer of the Cervix Uteri; Modification of the Takayama Operation.—H. Okabayashi.*

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXXIII OCTOBER, 1921 NUMBER 4

# RADICAL ABDOMINAL HYSTERECTOMY FOR CANCER OF THE CERVIX UTERI

## MODIFICATION OF THE TAKAYAMA OPERATION

BY H. OKABAYASKI, M.D., KYOTO, JAPAN
Assistant Professor of Obstetrics and Gynecology, Imperial University, Kyoto

IT has always been clear that to obtain good results in extensive abdominal operations for cancer of the cervix uteri, perfection in technique is of great importance. To Wertheim, to a great extent, belongs the credit of having simplified the technique of the more radical operation. Although the most important feature of the radical operation is wide excision of the parametrium where the disease shows the greatest tendency to spread, no one has so far succeeded in perfecting this step.

My beloved teacher, Prof. S. Takayama, has operated upon an average of 200 cases of uterine cancer a year, and this has given him great experience. For some time he has endeavored to improve the technique of the operation, and at last, after many difficulties, has arrived at a plan which is easier of accomplishment and at the same time embodies more radical removal of tissue than does the operation formerly used. About 10 years ago, Professor Takayama described his technique at a meeting of the Japanese Gynecological Association. One of the most important features of his method consists in the widest possible removal of the parametrium and of the cancer-infiltrated area before the isolation of the bladder from the uterus and the ureter from the parametrium. He has raised the operability in cancer of the cervix to 81.5 per cent, and his results have been good notwithstanding the fact that many patients came for free medical treatment and did not consult him until the disease was too far advanced for even radical operation. Encouraged by his good results, we were more anxious than ever to learn anything that would help to cure cancer of the cervix and to make extirpation more easy.

With the technique which I have developed while following the principles embodied in Professor Takayama's method, I feel that complete removal of the uterus is almost as simple and easy and fully as safe in very advanced cases as in cases in the early stages. Complete removal, so far as I can determine, does not produce a permanent cure in all cases, but I think a great majority of the cases do enjoy permanent relief.

### TECHNIQUE

Our method of procedure follows:

*Choice of route—abdominal or vaginal.* The cancerous growth is originally distinctly local, but it soon begins to spread through the lymphatics into the surrounding tissues. Therefore, the hope of cure rests upon early and complete extirpation of the growth, i.e., removal of the uterus and appendages, includ-

ing part of the healthy vagina and sufficient parametrial and paravaginal cellular tissues to leave only healthy tissue. Even with a large vaginoperineal incision, we have found that wide removal of connective tissue at the side of the cervix without accidentally injuring the neighboring structures—the bowels, the bladder, the ureter, the blood vessels, etc.—is barley possible and that it is impossible to reach the iliac glands. Observation of cases also showed that recurrence more often followed vaginal hysterectomy than abdominal hysterectomy. The results claimed by Schauta in a very large number of cases are nearly as favorable as those claimed by Wertheim, but his operability rate is considerably lower. Therefore, in our gynecological clinic we have made it a rule to use the abdominal route.

*Pre-operative preparation of the patient.* There is no special preparation of the patient upon whom operation for cancer of the uterus is to be performed other than that for any abdominal operation, except that the discharge from the cervical growth must be treated. The virulently infectious, sloughing tissue in the vagina, especially large cauliflower masses, must be removed by preliminary curettage and cauterization immediately after laparotomy. This must be done under local anæsthesia to eliminate the added strain which would be put upon the patient's heart if a general anæsthesia were used. We have used injections of pantopon-scopolamine.

The skin of the abdomen, the vagina, and the external genitals are disinfected. The preparation of the vagina is most important and has much to do with the result. The vagina should be thoroughly washed out with soap and hot water and then irrigated with a solution of 0.1 per cent sublimate or 1.0 per cent lysol. After this, an ounce or two of alcohol, 60 per cent, is poured into the vagina, and by a sort of pumping motion with pad of gauze held in sponge-holder forceps, the wall of the entire vagina is swept over. The sponge-holder forceps is then removed. The canal should be packed with gauze soaked in 60 per cent alcohol to check the bleeding, absorb any discharge which may be pressed out of the uterus, and keep the tissues as clean and free from infectious material as possible. For convenience in removing the gauze later, an end of it or a string which ties the gauze in the middle should be left long enough to protrude from the vagina.

*Position of patient for operation.* The Trendelenburg position is required, but an extreme tilt should be avoided; at all events the extreme position is maintained for as short a time as possible and only while the surgeon operates at the deepest point in the pelvis. There can be no doubt that where shock is marked, there is an immediate diminution in the force of the pulse as the patient is lowered from the extremely tilted position to the horizontal; therefore, the change of position should be carried out as gradually as possible.

*Anæsthesia.* One and one-half hours before operation, the patient is given a hypodermic injection of pantopon with scopolamine hydrobromide, and immediately before the operation this is usually followed by spinal anæsthesia. If this fails to produce satisfactory anæsthesia or the effect wears off before the operation is finished, inhalation anæsthesia may be added.

*The abdominal incision.* The abdomen is opened by the usual incision which should be made of sufficient length to secure free exposure of the field of operation; in all cases it should extend from the symphysis to the umbilicus and in obese patients an inch or more above the umbilicus. The patient is placed in the Trendelenburg position after the incision is made.

*Exposure of the pelvic cavity.* With the patient in the Trendelenburg position and the abdominal wound held wide open by means of a Doyen self-retaining retractor, a good view of the pelvic cavity is obtained in thin patients; in stout patients, however, the intestines obscure the operative field. In either case, by means of a large abdominal towel moistened with warm salt solution, the intestines may be held back against the diaphragm to keep them out of the operative field during operation and away from physical irritation and danger of infection. Thus the pelvis is easily walled off.

*Examination to determine operability.* The uterus and surrounding organs should be

examined to determine the advancement of the disease and the operability of the case. Involvement of the bladder is indicated by a puckered in-drawing of the peritoneum at the bottom of the uterovesical pouch. If on palpating the glands along the iliac vessels and aorta, large, fixed, hard masses are found adherent to the big vessels, the case is hardly operable. The parametrium should be examined and the mobility of the uterus determined.

In advanced cases the ureter passes through the cancer-infiltrated area, and the ureter is dilated. Although the ureter may at times be so dilated as to require resection, or the bladder so densely adherent to the uterus as to necessitate excision of part of the bladder, either condition alone does not contra-indicate operation; at the same time they are signs of extensive infiltration of the parametrium and are unfavorable symptoms. If the uterus is mobile and there is infiltration of the parametrium from the pelvic wall, extirpation is feasible, even though the infiltration is extensive.

In advanced cases it will usually be found that bilateral salpingitis is present and often there are many dense adhesions. Suppuration may be present in the tubes or ovaries. Pyometra is another common finding and in several cases the pelvic vessels were dilated. Such complications do not always contra-indicate operation, but in such cases the operation is very difficult and extreme care must be used. One condition which makes the operation most difficult is the cicatricial changes in the pelvic cellular tissue, the result of past inflammation.

Individual operators differ in their opinions as to the operability of a case, but generally speaking radical removal of the disease is undertaken when there appears to be a reasonable chance of excising the new-growth with the necessary amount of surrounding tissue. In attempting to estimate such chances there are many fallacies. With experience, however, we learn to discriminate which patients should be operated upon and which should not.

*Division of the broad ligaments.* The fundus of the uterus is grasped with a stout forceps and drawn forward. By traction on the forceps, an assistant draws the uterus to one side and downward. The operator grasps the broad ligament on either side, internal or external to the ovary, depending upon whether the ovary is to be removed or not. I used to save one ovary, either the right or left, in patients of the preclimacteric age. Ligatures are placed upon the infundibulopelvic ligament just outside the ovary. If an ovary is to be saved, the ligature is placed so as to catch the ovarian ligament and the fallopian tube close to the ovary. The round ligament on either side is ligated separately at a point about 2 or 3 centimeters away from the uterus. A stout forceps is placed at the horn of the uterus so as to catch the uterine artery at that point and the broad ligaments are divided immediately inside the ligatures. The incision on either side is continued forward in the direction of the entrance of the uterine artery into the uterus (i.e. close to the side of the uterus at the height of the internal orifice), and the round ligament is divided at the same time. Such an incision is large enough, when our technique is used, for the exposure of the ureters and the uterine vessels and for the radical removal of the pelvic tissue, and there is no need for wide incision, as for instance the Bumm incision, the use of which sometimes necessitates suturing the peritoneal edge after operation.

*Ligation of the uterine artery.* The uterus is held well over to the left side. After the right broad ligament is opened without cutting from the site of the ligature to the uterus, the posterior layer is picked up with forceps and drawn toward the median line. The uterine artery should be sought in its course from the pelvic side wall to the side of the uterus. The artery is easily found by gently separating the loose cellular tissue at the base of the broad ligament. As we attempt to ligate the uterine arteries close to their junction with the hypogastric—as that is the first step in the radical and satisfactory removal of the pelvic tissues—we separate the loose pelvic tissue at the base of the broad ligament from the back along the posterior pelvic wall, and in front, at the back of the anterolateral portions of the inferior surface of the bladder which should be separated in

its depth. After such preparation, the tissue running transversely from the pelvic side wall to the side of the uterus and the vagina, which always contains the uterine vessels, comes into view. The index finger is pushed carefully through the base of this tissue wall, isolating the uterine vessels and surrounding tissue from the pelvic wall. The arteries should be tied at two points; first, close to the origin from the hypogastric, and second, near the uterus, and divided between the two ligatures.

*Freeing the ureter from the posterior layer of the broad ligament.* The ureteral sheath adheres to the posterior peritoneal layer of the broad ligament, and in detaching this layer from the side of the pelvis, the ureter naturally goes with it and so remains out of harm's way. Now the ureter with its sheath should be separated from the posterior layer of the broad ligament to the entrance into the parametrium for a distance of 3 or 4 centimeters posteriorly. The same should be done on the opposite side.

*Separation of the rectum.* The uterus is drawn forward and the rectum with the peritoneal covering is stretched back and upward (Fig. 1). Thus the peritoneum is raised so high at the bottom of Douglas' pouch that it nearly disappears. An incision is made upon the lifted-up peritoneum and carried with scissors across the back of the cervix so as to connect the lateral incisions posteriorly; to be more exact the peritoneum is cut at the boundary line of its reflection from the posterior fornix of the vagina on to the front of the rectum. At the same time the rectum is gently freed from the vaginal wall with scissors or with the finger, or the two combined, i.e. the rectum is bluntly detached from the upper part of the vagina. The two canals are separated as far as the operator thinks necessary. If the separation is carried in the correct plane, there should be little or no bleeding during this step even though the rectum, the vagina, or the uterus itself be adherent.

*Removing the infiltrated and the loose cellular pelvic tissues.* The operator should assure himself that the rectum is completely separated, especially on the left side where it is apt to adhere to the uterosacral ligament. The uterosacral ligament on either side is stretched forward by means of long pressure forceps, and at the same time the parietal peritoneum which covers the posterior wall of the pelvis is drawn backward. Then with long curved scissors, the uterosacral ligaments are divided at their bases on the pelvic wall.

The rectum should be pulled toward the median line and upward with the left hand of the operator or with a Takayama rectum retractor. The uterus is drawn forward forcibly by means of long pressure forceps on the uterosacral ligament; thus the right lateral cervicopelvic or Mackenrodt ligament and the loose tissues in the pelvic floor are stretched and easily attainable. The ureters should be held aside by the retractor. With very long curved scissors the pelvic loose cellular tissue should be cut off very carefully, bit by bit, close to the pelvic wall, until the pelvic vessels which run from the lateral wall to the bladder and the vagina, i.e., vaginal and inferior vesical vessels, are seen. At this point Professor Takayama uses a special instrument for dissecting the loose cellular tissue which is to be removed from the depths of the vessels which are lying in the parametrium. This instrument does not injure the vessels. For this purpose I employ scissors, which are now commonly used. A few strokes with the index finger or with the tip of closed, long curved scissors deeply in the loose cellular tissue, on the outside of the female pelvic viscera along the pelvic side wall, suffice to strip off the parametrial tissue and the cancer-infiltrated area from the pelvic side wall, leaving only a very thin tissue band containing generally two large veins and one small artery (inferior vesical artery and veins). By this manœuver, no matter how extensively infiltrated the parametrial tissue is, it should be thoroughly dissected. This leaves the parametrium entirely detached, and, if not previously exposed, the large veins now lie bare on the pelvic floor. A long, curved pressure forceps is placed close to the pelvic wall upon the parametrial tissue at the base of the lateral cervicopelvic ligament and another forceps

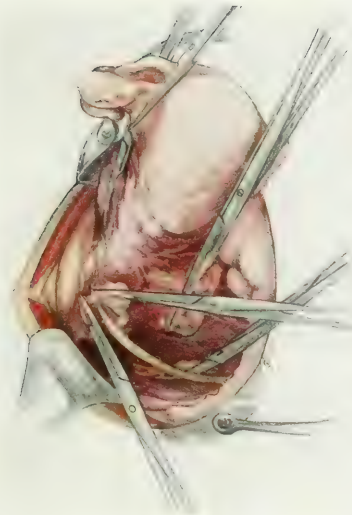

Fig. 4. Opening the ureteral canal. The uterus is drawn to the right and more or less backward. Both cut edges of the cervicopelvic ligament secured by long pressure forceps are fairly visible.

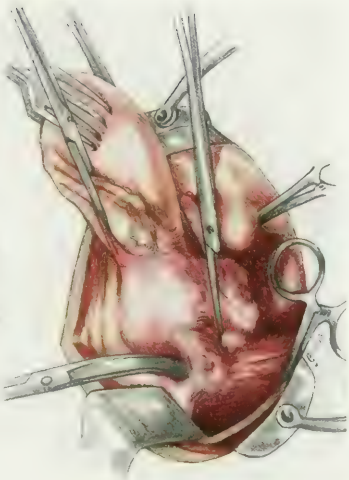

Fig. 5. Application of the curved scissors between the anterolateral portion of the inferior surface of the bladder and the side wall of the vagina. The left portion of the cervicopelvic ligament is drawn medianward by forceps while the ureter and lateral portion of the bladder are drawn aside by a broad retractor, producing tension on the anterolateral paravaginal tissue.

*Radical Abdominal Hysterectomy for Cancer of the Cervix Uteri; Modification of the Takayama Operation.—H. Okabayashi.*

as close to the uterus as possible. The operator cuts between the clamps near the forceps on the pelvic side (Fig. 3). By this one simple step the parametrial tissue is removed very easily and radically without any loss of blood, until the muscles of the pelvic floor are seen and the rectum is laid bare. Mackenrodt has always criticised Wertheim claiming that by his method more parametrium is left on the pelvic floor. We must agree to this, unfortunately, for unless the preparation described above is carried out, the clamps cannot be applied sufficiently close to the attachment of the parametrium to the pelvic floor so that excision can be carried out without leaving parametrial tissue and a ligature cannot be applied so securely but that bleeding occurs at different points.

The same technique should be followed on the other side.

*Separation of the bladder.* The peritoneum is divided across the front of the cervix, just above the reflection of the bladder or at the boundary line between the parts in such a way as to connect the lateral incisions. Where no morbid adhesions are present, the bladder with its peritoneal covering is pushed down from the anterior surface of the cervix and the vagina by means of gauze pads, and if necessary by a few light snips of the scissors or the scalpel. Where gross adhesions are present very careful dissection is required to avoid injury to the bladder. In such cases venous oozing is sometimes present. It is obvious therefore that while the separation can be effected it is better to delay this step until later for the bladder is usually found involved in the cancerous growth and fixed to the uterus, and complete separation would entail a great deal of oozing.

*Isolation of the ureter.* The ureter should now be separated from its bed to the entrance into the bladder. The uterine cut end of the uterine artery is raised up with pressure forceps and the loose tissue at the entrance of the ureteral canal is divided parallel with the course of the uterine artery. Thus the sheath of the ureter is split open and the entrance of the ureteral canal comes into view. The curved scissors with the concave side pointing downward are insinuated into the canal and the ureters pressed downward with it. In this way the canal is so enlarged that the ureters, which have already been separated from the surrounding tissue, are laid bare on the bottom of the canal throughout their course. Professor Takayama has constructed special instruments for enlarging the ureteral canal. These instruments are used in place of my scissors. Avoiding the ureter, the operator places two curved forceps on the front wall of the ureteral canal along the course of the ureter and the incision is made with scissors between the two forceps (Fig. 4). As several vessels crossing from the bladder to the cervix will be divided in this proceeding, they must be secured by ligatures. If this step does not produce the desired result, it should be repeated near the bladder along the ureteral canal. The ureters are shelled out from the opened ureteral canal.

On account of the proximity of the lower portion of the cervix to the ureter, it requires at this level but little outward extension of the growth to reach as far as, or beyond, the ureter. It is therefore, often necessary to dig the ureter out of the cancerous infiltrated parametrium, so that the uterus shows afterward a deep sulcus, representing the place where the ureter was fixed. Even in such advanced cases the ureters are very easily isolated without any bleeding or danger of injury to them and to the periureteral vessels.

*The completion of the separation of the bladder* is effected by continuous snipping with scissors and gentle pressure with gauze and finger. The extent to which dissection is desirable varies in different cases, but it should certainly be not less than 1.5 to 2 centimeters below the lowest level or growth. The insertion of a broad retractor to hold back the bladder above the line of separation is very useful.

*Division of the anterior lateral paravaginal and parametrial tissue.* This tissue connects the posterolateral aspect of the bladder with the side wall of the vagina and the cervix of the uterus and contains many venous vessels. Division of this tissue is a difficult procedure as more or less bleeding is always present and there is always the danger of injuring the

bladder, especially in advanced cases. The cancer-infiltrated area running from the cervix and the vagina laterally and backward to the pelvic wall which was dissected free in the first step, is drawn to the median line by long pressure forceps. The curved scissors are insinuated into that part where the posterior wall of the bladder and the anterolateral wall of the cervix are connected more loosely, about 2 or 3 centimeters behind and lateral to the entrance of the ureter into the bladder. The bladder with the ureter should be retracted laterally (Fig. 5). The connective tissue to be cut off now becomes visible, stretched out as a thin, deep, transverse running membranous band, which should be grasped by two straight long pressure forceps, one as near the bladder as possible, the other to the side wall of the uterus. The band should be divided between the forceps and ligated. To remove sufficient tissue in advanced cases, it is sometimes necessary to continue the excision downward to a depth determined by the operator.

Using this method we have no bleeding and the fear of injuring the bladder is eliminated. Moreover, the operative field, after the incision, is greatly enlarged and the lateral paravaginal tissue which has many venous vessels is easily treated, for the tissue is directly in our vision and extirpation can be done as precisely and radically as one wishes.

*The division of the lateral paravaginal tissue.* The uterus with its surrounding tissues and the cancer-infiltrated area is separated from the pelvic wall and viscera, and only the lateral vaginal tissue remains to be separated. This tissue should be tied off by two or three mass ligatures which can be easily placed as far out as we wish, depending upon the degree of infiltration. The tissue is cut and the uterus is attached merely to the vagina. The tissues at the side of the cervix and the vagina are now cleared away down to the bony pelvic side wall.

*Division of the vagina.* The gauze previously placed in the vagina is withdrawn and an assistant wipes the vagina dry through the introitus. A Wertheim clamp is applied to the vagina just above the point where the bladder is attached. At the same time it is advisable to apply a right-angled pressure forceps to either side of the vagina below the clamp to control bleeding from the lateral vaginal vessels and to fix the vaginal wall so that it will not be retracted. The operator then applies a hot Paquelin cautery immediately below the clamps and above the right-angled forceps which hold the lateral walls. Gauze is pushed into the opened vaginal cavity so as to absorb any discharge which may have been expressed from the uterus during manipulation. Tincture of iodine is painted over the inner surface of the vaginal wall. After this, the vaginal wall is cut completely around. The anterior and posterior vaginal walls are grasped with forceps and the vaginal cavity is sponged again with a pad of gauze which is held in a sponge holder forceps. If no fear of infection is present the vaginal wound is immediately closed.

*Applying the ligatures.* With the exception of the forceps holding the cut edge of the vagina, we have only one pressure forceps in the operative field on either side, and this forceps is placed on the pelvic floor to prevent oozing after division of the lateral cervicopelvic ligament. These forceps are now removed one by one after careful ligation of the tissues contained in them. If this is not done thoroughly very troublesome oozing will follow. The application of the ligatures deep down in the pelvis is facilitated by the use of the Takayama dull needle.

*Removal of the pelvic glands and lymphatic tracts.* Though in theory it would be best to remove all the regional glands and lymphatic tracts in one piece with the primary growth, in practice it is hardly possible and so only a few glands are removed with the uterus (Fig. 6). The removal of the glands, therefore, should be done in the second stage of the operation, and only the palpable, enlarged glands with the surrounding connective tissue are dissected out. The glands are removed solely by means of the finger and as far as possible are taken out in one piece. We have never found cancer in glands of normal size.

*Suture of the peritoneal floor.* After all oozing has been controlled, and there is seldom loss of blood with our technique, the peritoneum is closed in the usual manner from side to side over the stump of the vagina. The sutures are passed several times across the cut edge of the vagina and the bladder, which has been loosened from its position in removing the surrounding tissues and uterus, is thus more or less fixed. Sometimes there results postoperative retention of urine. A plan to prevent postoperative paralysis of the bladder will be published some other time. All raw areas should be covered over with peritoneum.

In cases in which infection is suspected the upper end of the vagina is partly closed by sutures at either side, and an opening in the middle left for drainage of the subperitoneal space. A gauze drain may then be placed on either side of the pelvis and in the vaginal cavity, using care that it does not come in contact with the ureter. The peritoneal cavity should also be drained into the vagina.

*Closure of the abdominal wall.* The abdominal wall is closed in three layers in the usual way.

Fig. 6. Specimen of squamous-celled carcinoma of the cervix in the advanced stage. This tumor was removed by the author and the result has been very satisfactory. The disease had spread in all directions and the parametrium was very much thickened due to the carcinomatous infiltration. Some enlarged lymph glands are visible within. The upper half of the posterior wall of the vagina is invaded by the growth.

SUMMARY

1. The technique which I use is quite different from other methods employed in treating cancer of the uterus.

2. With my method any case of cancer of the uterus, whether in a very advanced stage or in a primary stage, can be operated upon very satisfactorily. I might say that the dangers and sources of failure which occurred in my earlier operations with the Wertheim method have almost disappeared.

3. The control of bleeding is the most difficult problem in the radical abdominal operation, because in the radical operation the parametrial tissue is widely extirpated. Our method renders extirpation easy and bloodless, even though the parametrium is extensively infiltrated with cancer and though one excises the tissue near the pelvic floor.

4. With improvement in our operative technique the operability percentage has been raised and primary mortality has decreased.

5. We hope to be able to report much better results next year, when our cases will have passed the five-year period. So far the results have been very satisfactory.

Of course, I do not feel that the method described has been perfected in all particulars, but I do believe that it is one of the most perfect that has been designed for the treatment of cancer of the cervix of the uterus. If good results in the treatment of cancer of the cervix are secured with this method, it will bring great happiness to women. The honor for perfecting the technique should naturally fall to my revered teacher, Professor Takayama, and it is to give credit to him that I have described the operation.

# A TENDON TRANSPLANT FOR INTRINSIC HAND MUSCLE PARALYSIS[1]

By K. WINFIELD NEY, M.D., New York

THE results observed following suture of peripheral nerves have surpassed all expectations, but the apparently slow rate of regeneration through the distal segment of a sutured nerve is often discouraging to the patient, and the surgeon may have to wait many months before he is rewarded by an objective sign of a successful suture, i.e., the return of voluntary power in the formerly paralyzed muscles.

The return of voluntary power is first observed in the larger muscles, very weak at first, but gradually increasing in strength. The smaller and more distally located muscles, such as the intrinsic muscles of the hand and foot, are the last to show returning voluntary motor power. This is due to their location and the great amount of time required for the regenerating motor neuraxones to reach the end plates in the muscle fibers at their distal location. Another factor of great importance is the muscular volume of these intrinsic muscles which is so small that during the long period of paralysis, before the regenerating neuraxones can reach them, they have undergone marked atrophy, and retain but little of their former muscular tissue. Nature has so arranged the nerve supply of the intrinsic muscles of the hand that a paralysis of only one nerve, median or ulnar, produces a minimum of disability; but when the lesion involves both nerves, as so frequently happens in injuries involving the neurovascular bundle in the upper part of the arm, the disability is extreme. In combined median and ulnar nerve paralysis regeneration of the extrinsic muscles is more or less complete in 12 to 18 months following a successful nerve suture, but in a series of 42 cases of combined median and ulnar paralysis which have had a successful restoration of most of the extrinsic muscles, there were but three which showed on last observation any evidence of returning voluntary motor function in the intrinsic hand muscles supplied by these nerves.

In complete intrinsic hand muscle paralysis the greatest disability is the loss of the opposing action of the thumb. The fingers are flexed at the interphalangeal joints by the long extrinsic flexors—flexor sublimis and profundus digitorum—and when the long flexor of the thumb (an extrinsic muscle) has regained voluntary power, the distal phalanx may be flexed; but this partial function is of but little value inasmuch as the thumb lies flat against the outer side of the palm and is totally inactive in so far as all opposing action is concerned.

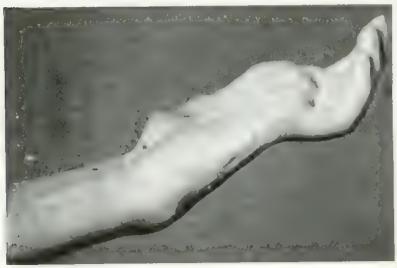

Fig. 1. Intrinsic hand muscle paralysis. Palmar view of "flat" or "ape hand."

Fig. 2. Dorsal view of intrinsic hand muscle paralysis showing atrophy of the interossei muscle and the action of the active extensors in pulling the thumb to a position of hyperextension. Patient is endeavoring to flex hand. Voluntary power has returned in the long flexor of the thumb so that the distal phalanx can be flexed.

Read before the Orthopedic Section of the New York Academy of Medicine, December 1, 1922.

Fig. 3. Another view of the flat hand of intrinsic hand muscle paralysis with return of function, following nerve suture, in the flexor sublimis and flexor profundus digitorum, no power having yet returned in the long flexor of the thumb.

Fig. 4. Another picture similar to Figure 3 with return of voluntary power in all the extrinsic muscles except the long flexor of the thumb.

Fig. 5. Typical flat hand showing return of power in the extrinsic muscles except the long flexor of the thumb. The tendon of the palmaris longus stands out prominently.

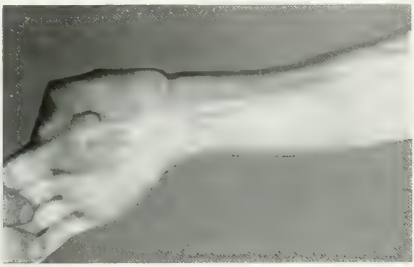

Fig. 6. Flat hand with return of function in all the extrinsic hand muscles. The tendon of the palmaris longus stands out prominently.

Fig. 7. Intrinsic hand muscle paralysis with return of power in the long flexor of the thumb. Normal hand shows thumb in the opposed position. Defective hand shows the attempt by action of the long flexor of the thumb, flexing the distal phalanx which hugs the palm.

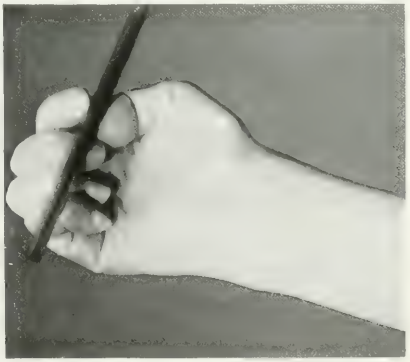

Fig. 8. The method of picking up a pencil in intrinsic hand muscle paralysis where the thumb cannot be opposed.

Fig. 9.

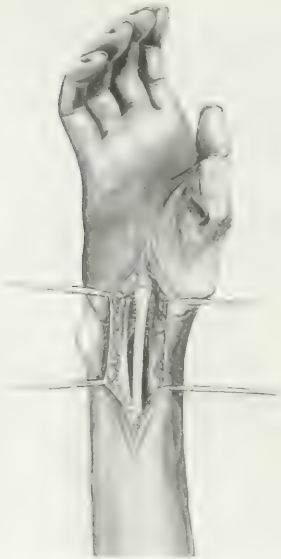

Fig. 10.

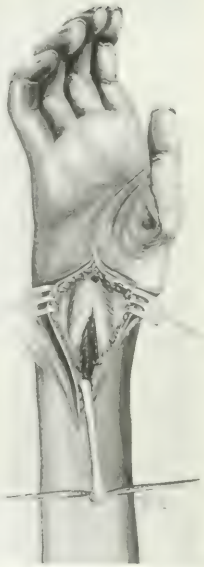

Fig. 11.

Fig. 9. First stage of operation—dorsal incision extending from metacarpophalangeal joint to 3 centimeters above attachment of the extensor ossis metacarpi pollicis exposing the short extensor of the thumb, also showing its relation to the extensor ossi metacarpi pollicis.

Fig. 10. Exposure of the palmaris longus tendon, as it passes above the annular ligament.

Fig. 11. Palmaris longus tendon sectioned; the passage under the anterior annular ligament and the opening in the palmar fascia.

It was for the correction of such a disability as this opponens paralysis which led me to consider ways and means whereby the thumb might be held and retained in a more normal position and prevent the overstretching of the intrinsic thumb muscles by the active extensors—believing that their constant stretching, by the pulling of the thumb backward greatly retarded regeneration. Various types of splints and thumb straps were used but because of their inconvenience when worn the patient refused to use the hand to the detriment of the other regenerating muscles, or neglected to wear the splints because of their encumbrance. Finally, I devised an operation done under local anæsthesia, to correct the deformity and to relieve the stretching of the paralyzed intrinsic muscles. After several modifications, the technique described below was used. The short extensor tendon of the thumb was passed through a tunnel under the anterior annular ligament and transplanted into the tendon of the palmaris longus, or that muscle being absent (about 20 per cent of cases) into the flexor carpi radialis. The results of this transplant proved so satisfactory, and was accompanied by such an early restoration of thumb function that it ceased to be considered merely a splinting operation but one definitely "corrective" in nature. Its advantages are evident, and we may hope ultimately for regeneration in the paralyzed muscles which are in no way injured by the operation. The only muscles

sacrificed are the short extensor of the thumb and the palmaris longus, the loss of which is productive of no determinable disability.

### OPERATIVE TECHNIQUE

Local anæsthesia is obtained by infiltrating the skin in the lines of the proposed incisions, with a 1 per cent novocaine solution, to which is added 15 drops of adrenalin chloride to each 30 cubic centimeters of solution. Following the skin injection the subcutaneous tissues are infiltrated down to and including the tendon sheaths. The subcutaneous tissues of the thenar eminence are also infiltrated in a similar manner. After the injection of the anæsthetic solution, pressure is made over the infiltrated area for a period of about 5 minutes. This latter procedure is important in local anæsthesia, as it increases its intensity and duration. The use of adrenalin chloride eliminates much troublesome oozing, and the operation may be entirely bloodless if the larger vessels are clamped before division. This is important because the presence of oozing not only interferes by obscuring the dissection, but it is also responsible for subsequent adhesions which tend to interfere with the ultimate movement of the transplanted tendon.

*First stage.* The dorsal incision for exposing the tendon of the short flexor of the thumb is made from the metacarpophalangeal joint to 3 centimeters above the attachment of the extensor ossis metacarpi pollicis following the line of this tendon running near the palmar side of the anatomical snuff-box. The extensor pollicis brevis lies from 0.5 to 1 centimeter

Fig. 12. Shows the transplanted short extensor of the thumb passed subcutaneously over the thenar eminence, under the annular ligament and anastomosed to the palmaris longus.

Fig. 13. Restored position of the thumb following the transplant.

Fig. 14. The opposed action of the thumb in picking up a pencil following the transplant.

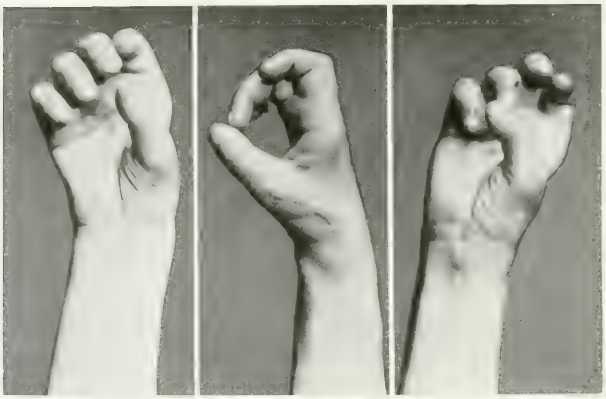

Fig. 15. Fig. 16. Fig. 17.

Fig. 15. Another view of hand shown in Figures 7 and 8 in the correction of the thumb paralysis following the transplant. Thumb in resting position—palmar view.
Fig. 16. Same hand, resting position—lateral view.
Fig. 17. Same hand. Patient opposing thumb to side of little finger.

nearer the palmar border of the thumb than the extensor pollicis longus from which it must be differentiated, remembering that the long flexor of the thumb forms the dorsal edge of the anatomical snuff-box, the extensor ossis metacarpi pollicis forming the palmar edge. The sheath of the flexor brevis pollicis often unites with the sheath of the extensor ossis metacarpi pollicis and runs dorsally to this tendon and closely approximates it. The sheath of the short extensor tendon is opened and the tendon is dissected to a point about 3 centimeters above the insertion of the extensor ossis metacarpi pollicis. It is here divided. The tendon at the point of division should be grasped with forceps and pulled to see whether or not it extends the distal phalanx of the thumb. Frequently in the region of the metacarpophalangeal joint the short extensor tendon is intimately associated with the long extensor tendon, and if this should prove to be the case it should be corrected by careful dissection so that this extensor action will be felt only on the first phalanx of the thumb, remembering that extension of the distal phalanx should be accomplished only by the long extensor. The tendon is now wrapped with wet gauze and the palmar surface of the hand is exposed.

*Second stage.* The palmar incision—a ventral incision is made over the prominence of the palmaris longus tendon and palm for about 9 centimeters, 6 of which expose the palmaris longus tendon and 3 centimeters extends over the palmar fascia. The sheath of the palmaris longus tendon is opened and the tendon divided at a point where it begins to spread out into the palmar fascia. The tendon is then wrapped in gauze and held back over the wrist. Attention should now be directed to the bed which was formerly occupied by the palmaris tendon, under which will be found the median nerve, and at this point great care should be used to prevent injury to this structure. By passing a pair of curved forceps distally in the bed of the tendon, they will be found to pass readily under the anterior annular ligament into the palm of the hand; when the point of the forceps is felt under the palmar fascia, a transverse incision is made through this structure sufficiently large to permit the forceps to pass through without constriction.

*Third stage.* The superficial fascia including its fat is undermined over the thenar emi-

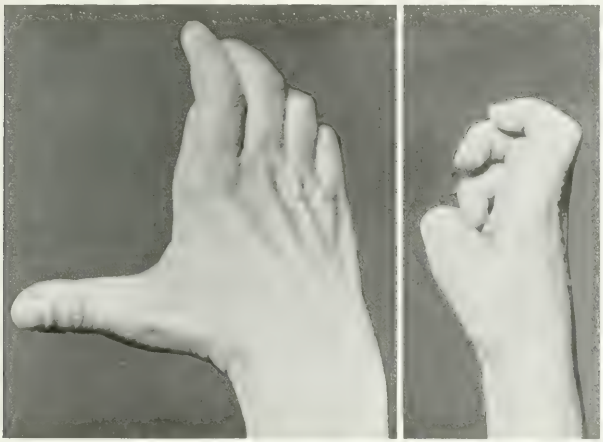

Fig. 18 (at left). The thumb extended following the transplant.
Fig. 19. The thumb flexed following the transplant. This action in the thumb is entirely the result of the transplanted tendon. A comparison of Figures 17 and 18 will serve to illustrate the range of motion afforded by the operation.

nence and the dorsal and palmar incision subcutaneously connected while another pair of forceps is passed through this undermined subcutaneous channel. At this point the cut end of the extensor brevis pollicis tendon is grasped by the forceps and pulled through the channel to the palmar incision.[1] It is here again grasped by the forceps passing under the anterior annular ligament and again pulled under this structure where it enters the wrist in the bed formerly occupied by the palmaris longus tendon. The pulling on this transposed tendon now occupying the new position will produce a typical opposing action of the thumb. With the thumb held in this position and the hand flexed on the wrist the transposed tendon is united to the tendon of the palmaris longus, which was divided earlier in the operation, endeavoring to overcorrect somewhat the normal position of the thumb.[2]

[1]We have found it advisable before transposing the tendon of the flexor brevis pollicis to lubricate the channels through which it is directed by pulling through them several times a piece of rubber which had been dipped in liquid paraffin, liquid petrolatum, or liquid alboline; we believe that its use both in the subcutaneous passages and on the tendon itself may be beneficial in the prevention of adhesions.

[2]When the palmaris longus is absent, the short extensor tendon is transposed under the annular ligament in the same manner, and is attached to the flexor carpi radialis without the division of this latter tendon.

After a firm anastomosis is made between these tendons the patient is asked to extend his thumb, without allowing him to place too much strain on the anastomosis. The tension on the tendons when properly sutured should bring the thumb back over the palm of the hand when the patient relaxes his extensors. The transposed tendon now runs under the annular ligament and occupies a position deeper than that formerly occupied by the palmaris longus.

*Fourth stage.* The former sheath of the palmaris longus is now closed over the transplanted tendon and the palmar and dorsal skin incisions closed. The hand and wrist should be retained in flexion—the thumb occupying its new position—by suitable bandaging and splinting to avoid too great tension upon the united tendons. The hand and forearm should remain splinted in this manner for about 1 month; dressing should be changed every second or third day and gentle passive movements insisted upon to prevent the formation of adhesions.

After the splints have been removed, we believe it advisable to hold the thumb in its

abducted and opposed position by means of a roll of bandage placed between the palmar surface of the thumb and palm of hand, and the thumb held over this by an adhesive strap or bandage which can be removed daily for manipulation of joints, etc. After 6 weeks, it is sufficient to support the thumb in this manner at night only; and after 2 months, splinting it may be discarded.

### MUSCLE TRAINING

Before operation the patient should be shown the action of his palmaris longus, and be taught how to contract this muscle. Two weeks after operation he should again start contracting the palmaris longus. These contractions should continue as a daily part of his treatment. By doing this, it will be much easier after all dressings are removed, for this muscle to take upon itself its new function of opposing the thumb. Following this operation, with the assumption of a new position by the thumb, the long flexor of the thumb can now work to advantage and it is possible for the patient to pick up objects and handle them in a more normal manner, so that the usefulness of the hand is greatly enhanced. The splinting action of this transplant also relaxes the intrinsic muscles of the thenar eminence and prevents their overstretching by the active extensors, and in this way keeps them in better condition until they shall again receive their regenerated nerve supply and resume normal function.

## THE INDICATIONS FOR SURGICAL TREATMENT IN THE DIFFERENT TYPES OF GOITER

By W. E. SISTRUNK, M.D., F.A.C.S., Rochester, Minnesota
Section on Surgery, Mayo Clinic

PLUMMER, after years of painstaking study of thousands of cases of goiter, claims that there are only three definite types of goiter, colloid, adenomatous, and exophthalmic, and that all the other types seen clinically are either variations or combinations of these three. A simple classification like this does much toward eliminating confused ideas with regard to the various types of goiter discussed in the literature. Since the number of patients operated on for goiter is constantly increasing the question of the indications for surgery in the different types becomes important.

### COLLOID GOITER

Colloid goiter is definitely a goiter of youth; probably it is never seen in persons more than 30 or 35 and occurs most frequently between the ages of 15 and 25. In this group are included many of the so-called adolescent goiters, the type which usually produces the uniform fullness of the neck, so often seen in young women. Such types are not infrequently associated with nervous symptoms and tachycardia that render the differentiation of exophthalmic goiter quite difficult, especially if of the vasomotor type with thrills and bruits. The basal metabolic rate is, however, normal or slightly lower than normal, never increased; thus colloid goiters may be absolutely distinguished from exophthalmic goiters. In such cases a marked reaction to epinephrin (Goetsch's test) is obtained and the goiter is therefore frequently diagnosed exophthalmic and erroneously operated on.

Clinically, colloid goiter is recognized by the symmetric enlargement of both lobes and of the isthmus of the thyroid which it produces and by the characteristic soft, granular feel it imparts to the palpating fingers. In many instances it produces no symptoms except slight nervousness or worry over the knowledge of the fact that it exists. Microscopically, it differs from normal thyroid tissue in that the acini are dilated and filled with colloid material, while the epithelium lining the acini is low and flat in appearance.

Colloid goiter is the only type of goiter which disappears under the administration of iodine or thyroxin and should not be considered a surgical condition. Its failure to disappear under the administration of these agents probably indicates that it is not a simple colloid goiter, but one of the mixed types often seen, in which a colloid goiter is associated with small adenomatous growths of the thyroid. When such goiters are treated with iodine or thyroxin, the colloid portion disappears and the goiter is reduced in size, but the adenomata remain and are then more easily recognized. Colloid goiters may recur when removed surgically unless iodine or thyroxin is administered as a postoperative measure.

### ADENOMATOUS GOITER

The adenomatous goiter is the most common type. Although it often seemingly develops in persons of middle age, the probabilities are that its true origin in such persons dates back to early life, as by far the greater number give a history of having first noticed the enlargement of the thyroid at some time between the ages of 15 and 20.

The enlargement of the thyroid is produced by the growth, within the substance of the thyroid gland, of encapsulated adenomata which probably have developed from fœtal rests. The growth of these adenomata begins in early life and they may increase in size either slowly or rapidly. In the early stages of their development they do not produce symptoms except in rare instances in which they develop in a position such as to cause pressure on the trachea. At times they produce an enormous enlargement of the thyroid gland and most of the large goiters are of this type. Degenerative changes are prone to occur, usually through hæmorrhages within the capsule of the adenomata, and, according to the degenerative change which predominates, the various clinical varieties of goiter such as hæmorrhagic, cystic, and calcareous have received their names. There is not infrequently a decrease in the secretory activity of the gland, producing a condition of mild hypothyroidism with a lowered basal metabolic rate.

The adenomatous type of goiter, however, does not always remain simple and nontoxic. Plummer has found that 23 per cent of the patients with adenomata of the thyroid who present themselves for examination at the Mayo Clinic are found to be suffering from hyperthyroidism, but that the sypmtoms of hyperthyroidism had not developed until the goiter had been present for an average of 16 years. The hyperthyroidism which we find associated with adenomata produces a clinical picture different from that seen in exophthalmic goiter. The two conditions are often confused, but within recent years Plummer has shown definitely wherein they differ, and has proved that the condition in which hyperthyroidism is found associated with adenomata without diffuse parenchymatous hypertrophy is a definite clinical entity. Boothby has also clearly shown the differences between "adenomata with hyperthyroidism," as described by Plummer, and exophthalmic goiter.

Adenomatous goiters seldom produce toxic symptoms in persons under 30. When toxic symptoms develop the metabolic rate is found to be increased, although it is not so high as the rate in cases of exophthalmic goiter. The body is differently affected by the long-continued mild hyperthyroidism in this disease and by the rapidly increasing, severe hyperthyroidism of exophthalmic goiter; in the former the cardiovascular system suffers more severely, while in exophthalmic goiter the nervous system is more profoundly affected. Often the condition goes unrecognized until symptoms of myocardial degeneration occur and the patient begins to suffer from palpitation, arrhythmia, and later, dyspnœa and œdema. Unless the myocardial changes are very marked the condition is almost always associated with increased blood pressure. Other symptoms of hyperthyroidism such as tremor, flushed moist skin, tachycardia, and loss of weight and strength are present.

Clinically adenomatous goiter may be recognized by the irregular type of growth which it produces; the thyroid is asymmetrically enlarged and a single or many rounded tumors may be felt on palpation. These

tumors may be cystic, soft, hard, or even stony-like on palpation, according to the degenerative changes that have occurred. Microscopically, areas of encapsulated adenomatous tissue are found scattered throughout the thyroid gland. The acini in these adenomatous areas may be of fœtal type or they may resemble the acini in the fully developed thyroid when they often contain large amounts of colloid material. Up to the present time it has been impossible for pathologists to note definite changes in either the thyroid tissue or the adenomatous tissue in toxic adenomatous goiters by which a diagnosis of hyperthyroidism can be made.

Adenomatous goiters are, in the majority of instances, best treated by surgical measures, but in advising operation certain factors should be taken into consideration. Since it is known that these goiters do not produce toxic symptoms at the time of life when they usually develop and that the thyroid gland at that particular time of life is very essential, it seems best to defer operation in young persons. Moreover, these growths usually involve both lobes of the gland and when young persons are operated on it is quite likely that small adenomata that cannot be palpated, even after the thyroid is exposed, will be left, and thus increase the chances for recurrence of the goiter. For these reasons, we usually recommend that small adenomatous goiters in young persons shall not be treated surgically until the age of 25 or 30 is reached, except in instances in which the goiter increases in size sufficiently to cause considerable deformity or pressure. If, when this age has been attained, any of the adenomata are found to be as much as 3 or 4 centimeters in diameter, a partial thyroidectomy should be done. In a healthy person at this age a thyroidectomy may be done with such an extremely small risk that it seems better to advise operation than to allow the goiter to remain and thus subject the patient to the chance of later developing toxic symptoms. If the goiter is producing toxic symptoms when the patient is first seen the condition is definitely surgical, provided the damage to the patient has not been such as to make operation too hazardous. The removal of toxic adenomata causes the metabolic rate to drop quickly to normal and to remain normal, and in practically all of the patients very marked improvement immediately follows such an operation. The operative risk in certain patients who are toxic and in whom myocardial changes are marked is much increased and treatment of the heart condition by means of rest and digitalis is often a necessary preliminary to operation.

### EXOPHTHALMIC GOITER

Exophthalmic goiter may occur at any age, but is probably most often seen in the third and fourth decades of life. In many instances the condition develops suddenly with a rapid increase in the severity of symptoms, but in some patients its onset is insidious and severe symptoms do not develop until the second six months of the disease, at which time the patient often passes through a period of severe toxæmia in which all of the classic symptoms of exophthalmic goiter are present and which is termed a thyroid crisis. In others, the disease tends to run a chronic course without the development of a true crisis. As a rule, such symptoms as nervousness, tachycardia, tremor, flushed moist skin, and loss of weight and strength begin rather shortly after the onset of hyperthyroidism, and in some instances even before an enlargement of the thyroid has been noticed.

After passing through a crisis the patient usually improves considerably, as far as the symptoms and general condition are concerned, but in the majority of instances at some time within the next few years he passes through another similar period. During these periods very marked damage occurs to the heart and vital organs and patients who escape death usually become chronic invalids as a result of the degenerative changes.

On palpation the gland in nearly all instances will be found to be symmetrically enlarged and quite hard. Microscopically the epithelium lining the acini is found to have undergone the hypertrophic changes which are characteristic of this disease; except in the late stages, very little colloid material is found in the acini. Clinically the condition may be recognized by the presence of

the symptoms enumerated, the type of enlargement of the gland, and an increased metabolic rate.

The best results in the treatment of exophthalmic goiter are obtained through surgery. It cannot be denied that certain patients improve and apparently recover under medical treatment. In the beginning of the disease, however, it is impossible to distinguish between the patients who may fall in this group and those who are destined to suffer severe damage as the disease progresses. Great responsibility is assumed, therefore, by advising medical treatment in early cases in which thyroidectomy might prevent the development of the severe conditions, and in many instances, the death of patients who would fail to improve under medical treatment. The mortality following surgical procedures in this disease has gradually decreased until it is possible by present-day methods to operate in a large number of consecutive cases of exophthalmic goiter without a death, but there are some patients who must be operated on with a relatively high risk in order to offer a chance for cure. The mortality is materially increased when poor judgment is exercised in selecting the type of operation which would be safest and best in a given case and in advising operation in certain cases that are nonsurgical at the time.

In patients whose vital organs have not been severely damaged at the time they are seen and especially if the loss of weight and strength has not been marked, and the metabolic rate is low, a primary thyroidectomy may be done with comparative safety. Often, however, the patient when first seen by the surgeon is so toxic or the vital organs are so badly damaged that primary thyroidectomy is a risky procedure, and it becomes necessary to perform one or two ligations of the thyroid vessels preliminary to the removal of the gland.

Ligation is performed with two ideas in view, first, as a means of testing patients who seem fit surgical risks for thyroidectomy, but concerning whom there is enough doubt to make ligation the safer procedure, and second, as a means of preparing patients for thyroidectomy. The reaction which follows ligation is similar to but less marked than that following thyroidectomy: this reaction consists of an increase in the pulse rate and temperature, vomiting, nervousness, and mental irritability; it usually begins within a few hours after the operation has been performed, gradually increases and reaches its height within from 36 to 48 hours, and then, if the patient survives, gradually subsides.

Patients are usually extremely dangerous surgical risks during acute thyroid crises. We prefer to treat them by means of rest, fluids, and careful nursing until the crisis is passed and there is a gain in weight with a corresponding subsidence of the pulse rate, the nervousness, and mental irritability. The metabolic rate usually drops considerably following a crisis; patients who have just passed such a period are, therefore, not likely to be thrown into an acute attack of hyperthyroidism by thyroidectomy, but the operation may prove a dangerous procedure because of the marked degenerative changes in the vital organs and the weak, degenerated heart muscles. In such patients we have usually found it safer to perform two superior polar ligations under local anæsthesia 7 or 8 days apart, thus preparing the way for thyroidectomy several months later.

The determination of the basal metabolic rate is a great aid in diagnosis in the early stages of exophthalmic goiter. It is a definite index at the time it is taken of the amount of hyperthyroidism, but it gives no indication of the amount of damage which has previously been produced and can therefore be used only as an aid in deciding the type of operation which should be performed on a given patient. The clinical pictures of patients with the same rate vary: Some patients develop a tolerance to an increased metabolism; for instance, one patient with a rate of +50 per cent may be in a crisis and extremely ill, while another with the same rate may show a very different clinical picture and be a fair surgical risk. Knowledge of the basal metabolic rate is of aid after operation in determining whether a sufficient amount of thyroid tissue has been removed and in deciding whether patients with symptoms indicative of hyperthyroid-

ism after operation should be operated on again for removal of a portion of the remaining gland.

The results obtained following thyroidectomy depend largely on the extent of damage to the vital organs at the time of operation, the best results being obtained in patients operated on early in the course of the disease before severe damage to the vital organs has occurred. If the damage to the organs has been extensive, it is impossible to restore the patient to normal health; the operation usually stops the hyperthyroidism and great improvement follows, but true organic damage cannot be repaired.

## SUMMARY

1. Plummer divides all goiters into three classes: colloid, adenomatous, and exophthalmic.

2. Colloid goiters occur in young persons, are not surgical, and respond to treatment with iodine and thyroxin.

3. Adenomatous goiters usually appear in young persons. Twenty-three per cent of the patients with adenomatous goiters seen in the Mayo Clinic show symptoms of hyperthyroidism, but these symptoms do not develop until the goiter has been present for an average of about 16 years. In young persons, unless the goiters attain considerable size or produce symptoms of pressure, they are not considered surgical. In the majority of instances after patients with adenomatous goiter have attained the age of 25 or 30, surgery is advocated. All adenomatous goiters associated with hyperthyroidism are considered surgical if the condition of the patient will permit an operation.

4. Exophthalmic goiters occur at any age, but most often between the ages of 20 and 40. The condition is best treated surgically and the best results are obtained in patients operated on early in the course of the disease before marked damage has been done to the vital organs. Many patients require one or two ligations of the superior thyroid vessels preliminary to thyroidectomy in order to make thyroidectomy a safer procedure. If care is exercised in selecting the type of operation which should be performed in a given case, the mortality following operation is low.

# RELAXATION OF THE VAGINAL OUTLET

## Is the Obstetrician Responsible[1]

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THE normal vagina is a closed canal, the anterior and posterior walls being in contact. A relaxed condition of the vaginal outlet is rarely seen in women who have not borne children, therefore, we must look upon childbirth as the etiological factor. I have been a witness in two hard fought lawsuits, in which the attending physicians were accused of negligence for permitting this relaxation to occur, and I am glad to report that the juries, after a careful hearing, decided in both cases in favor of the obstetricians. It is not unusual to hear a woman remark, that if she had received proper attention at childbirth a secondary operation would have been unnecessary. There is also a general impression in professional circles that a relaxed vaginal outlet can be prevented by properly suturing the perineum after labor. Hirst (1) says that "students are so well trained now that the hope is justified that a secondary operation of the perineum will soon be as rare as the need for operation for vesicovaginal fistula." I have operated on a number of women with relaxed vaginal outlets, who had been attended by the best obstetricians in the country and whose lacerations had been sutured immediately following labor. The confused and erroneous impression of this condition, which exists not only with the laity but also with the profession, needs to be cleared up. It is unnecessary here to go into minute details of anatomy of the perineum.

According to Cunningham (2) the vagina is a closed canal, the two walls being in contact, the rectum being in close proximity at the upper part of the vagina. As the rectum approaches the outlet it is separated by the perineal body. All anatomists agree that the closed condition of the vagina is due to the action of the levator ani muscle through its puborectalis portion. While this muscle keeps the walls of the vagina in contact, it is not a sphincter of the vagina.

Peter Thompson (3) claims that the sphincter action is produced by the levator ani and the bulbocavernosus.

Paramore (4) says: "The existence of the columns of the vagina depends upon the continued activity of the puborectalis. The existence of the perineal curvature of the gut and the sigmoid course of the vagina are similarly dependent on the continued activity of the same muscle." This muscle is equal in width to the sternomastoid, twice as thick as the diaphragm, weighing one-fourth as much as the external oblique (5).

The dynamic energy of the puborectalis as developed by Dickinson (6) ranges from 10 to 27 traction pounds. It is found one-fourth of an inch inside the hymen and is attached to the vagina by strong connective tissue. It passes down behind the rectum uniting with its fellow of the opposite side. Contrary to the views of the old anatomists, no fibers are sent to the mid-point of the perineum. The muscle acts as a sling and holds the rectum and vagina upward toward the pubis, closing the vaginal orifice. Dickinson (6) states that "contraction of this muscle is capable of so firmly closing the lower end of the vagina that coitus and vaginal examinations become impossible. In exaggerated cases spasm beginning during the orgasm has held the male organ so firmly as to prevent its withdrawal for sometime, in some cases until chloroform has released it."

Until recently gynecologists and obstetricians were united in the opinion that the muscle was ruptured during labor and many ingenious operations were devised for bringing together the divided ends. Recently a few of the gynecologists have taken an opposite view.

Studdiford (7) in an excellent article shows that there is a band of involuntary muscular fibers that stretches across the perineal body from the puborectalis on one side to its

[1]Read before the Southern Surgical Association, Hot Springs, Virginia, December 15, 1920.

fellow opposite. He states that the puborectalis is not injured during labor, but that a rupture occurs of the involuntary muscular fibers and that relaxation of the vaginal outlet is caused by the injury of these fibers, preventing the levator ani from firmly contracting.

Graves (8) in his last edition coincides with the views of Studdiford (7). I agree with Studdiford that the involuntary muscles do exist, but I do not believe that the rupture of these fibers alone will cause an open vagina. My own view is that a relaxation of the vaginal outlet is caused by a lack of tone of the levator ani muscle, due to the overstretching which occurs at the time of labor. The cases of relaxation of the vaginal outlet found in women who have not borne children are due to a poor muscular development which is not only seen in the perineum but is also associated with loose, lax, abdominal walls. In my opinion the involuntary muscular fibers that Studdiford (7) has mentioned are for the purpose of holding back the rectum in its normal position as it turns backward to form the anus. When these fibers are injured the rectum bulges into the vagina causing a rectocele. This theory easily explains why in certain cases a cystocele is present without a rectocele. If the levator ani maintains its normal function and a complete tear occurs without involvement of the involuntary muscular fibers, neither a rectocele nor cystocele will occur. On the other hand, if the levator loses its normal tone and the involuntary muscular fibers are not injured, a cystocele will occur but not a rectocele. If the involuntary muscular fibers are injured and the levator has not regained its normal function, cystocele and rectocele will both be present. I have never seen a case at operation, even with the most extensive cystocele and rectocele, in which the levator ani could not be demonstrated intact and without laceration. It is impossible in certain cases for an obstetrician, however skilled or experienced, to prevent relaxation of the vaginal outlet in those cases where the levator ani has been stretched to the extent that it will not regain its normal tone. Every laceration following labor should, of course, be repaired at once. This primary operation tends to prevent sepsis and in some cases a relaxed outlet, but not always. It is impossible for an obstetrician to determine at labor whether the levator ani will fully regain its function, and for this reason it is advisable for the patient to report for observation every few months for a period of 2 years.

There is no special operation to advise. It is essential that the rectum be pushed back in its normal position by blunt dissection after the vaginal flap is raised. The two portions of the puborectalis are then brought together in the median line by interrupted sutures. This takes up the slack in the muscle, makes a closed canal of the vagina and is followed by excellent results. If a large cystocele is present, a special operation on the anterior wall of the vagina is necessary.

## CONCLUSIONS

In conclusion I desire to emphasize the following:

1. Relaxation of the vaginal outlet is caused by overstretching of the levator ani muscle and lack of tone following labor.

2. It is impossible for the obstetrician to determine at labor whether the muscle will regain its normal function or not.

3. All lacerations following labor should be immediately repaired for the purpose of preventing sepsis, remembering that it will not prevent relaxation if the levator is overstretched. The condition is easily cured at secondary operation by bringing together the overstretched muscle in the median line by interrupted sutures.

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# CLINICAL AND EXPERIMENTAL OBSERVATIONS IN THE USE OF SALINE IRRIGATION IN THE TREATMENT OF DIFFUSE PERITONITIS[1]

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If one may judge from the published statistics of the various clinics, surgeons can view with pride the reduction of the mortality accompanying diffuse peritonitis. According to Douglas (5), in the period from 1888 to 1904, in the hands of the foremost American and foreign surgeons, 65 per cent of such patients succumbed; while the mortality for the years 1900 to 1904 inclusive was 55 per cent. Murphy (13), in 1908, was able to report the astoundingly low mortality of a little more than 4 per cent. Undoubtedly, several factors have contributed to effect this improvement in the results, and some of these measures have come to be so generally accepted and practiced in the treatment of diffuse peritonitis as to justify scarcely more than their mention.

In this class we can place early operation. There is no question that this factor alone is sufficient to explain fully the differences in the earlier and more recent statistics; for it is a well recognized fact that a frail patient operated upon within a few hours after the perforation of an ulcer or the rupture of an appendiceal abscess is a far better risk than a robust patient at the end of 48 hours, irrespective of what procedure is adopted at the operation. This is particularly significant when it is learned that all of Murphy's patients were operated upon in less than 40 hours, and this author emphasizes the desirability of even earlier operation.

In the same class is to be placed the free use of water or salt solution by rectum. There are, indeed, few surgeons today who do not consider this measure of the greatest importance in the treatment of patients suffering from any severe septic condition, and it seems particularly appropriate in reference to peritonitis where dehydration is the rule. I believe, however, that it is not sufficiently appreciated that even better results may be obtained by the use of the subcutaneous injection of normal salt solution in addition, for by this way, more rapid and larger absorption may be obtained, and we are not dependent upon the troublesome and uncertain proctoclysis.

Concerning other details of treatment, however, surgeons are not in such perfect accord. Thus, we find that there are those who do not favor the use of opium; some even going so far as to advocate the use of purgatives. In regard to posture also, there is a difference of opinion, some contending that absorption is delayed and the condition of the patient improved by the use of the head elevated position. It would be interesting to include in the discussion a consideration of these points, but at this time I am particularly concerned with the status of another debatable procedure; namely, the irrigation of the peritoneal cavity in the presence of a diffuse peritonitis.

According to some authors, the use of the adjective "debatable" in regard to the employment of irrigation in peritonitis is scarcely permissible, for they deem that the epoch-making paper of the late J. B. Murphy (13) closed the debate upon this subject. Thus, Hertzler (9) states: "Many have opposed it, and since Murphy excluded it from his method of treatment, it is but seldom used." With due consideration for the eminence of the opponents of this procedure, it does seem that, in their enthusiasm, they have overlooked the names of some surgeons who are entitled to a hearing; for such men as Mikulicz, Kammerer, Hartwell, Moynihan, Senn, Blake, Bevan, and Mumford, have advocated irrigation in the presence of a diffuse process.

Let us consider the objections that have been raised against the use of saline irrigation in the presence of diffuse peritoneal infection.

[1]Read before Southern Surgical Association, Hot Springs, Virginia, December 14-16, 1920.

1. It tends to produce shock by subjecting the patient to a longer operation.

2. It traumatizes the peritoneum and accelerates absorption.

3. It washes off the defensive phagocytes and removes the protective exudate. According to Murphy (13): "Washing removes the pus with its myriads of leucocytes, sent there for the sole purpose of protection." In reference to the peritoneal fluid, he says: "There can be no doubt that this fluid, small in amount though it is, has great bactericidal properties; it is increased greatly both in quantity and bactericidal potency even very early in peritoneal infections." Hertzler (9) says: "Much harm is done also by removing the natural defensive forces of the tissues. The exudate covering the surface of the peritoneum is composed of serum and cells and in just the measure that irrigation is effective it is harmful by removing this protective measure."

4. It spreads infectious material from the primary focus to areas of the peritoneum that had not previously been involved. It is probable that no operable case ever showed a true "general" peritonitis; at most, the process is a "diffuse" one and there are certain portions of the peritoneum which are not the seat of actual inflammatory changes. Murphy has pointed out that colon bacilli are constantly present in the immediate vicinity of a perforation, while cultures taken from more distant portions of the cavity may show the presence only of the harmless staphylococcus albus or, indeed, be actually sterile. Therefore, he contends that flooding the cavity with salt solution serves to sweep the colon bacilli to these hitherto uninvaded regions.

These objections may appear to constitute a severe indictment against the practice of peritoneal irrigation, but a closer analysis reveals that the basis upon which they rest is more fancied than real. It is indeed true that long exposure of the intestines to the air with the resulting drying joined to the trauma of excessive handling will give rise to a condition similar to surgical shock. Prolonged etherization also, as I have been able to demonstrate, will much reduce the resistance of animals to intraperitoneal infection, but these factors are by no means necessitated in employing irrigation clinically. As Reichel (14) first pointed out, and has been confirmed by Murphy and Buxton, overwhelming toxæmia may produce a condition closely simulating shock; and I am inclined to suspect that the added few minutes demanded by irrigation are less apt to cause this so-called shock than is the hasty, ill-executed operation performed in accordance with a too literal acceptance of the dictum: "Get in quickly—get out quicker." Impressed with the desirability of excessive speed, the operator is apt to leave in the peritoneal cavity bacteria, toxins, and material which will serve as culture media for the bacteria, with the result that the shock-like toxæmia takes place.

Wegner (18) first showed the influence of injecting albuminous material along with the bacteria, and Grawitz (6) emphasized the great increase in the virulence of the organisms produced by the simultaneous injection into the cavity of such substances as blood clot, agar, or gelatin with the bacteria. Similar observations have been made by Waterhouse (17) and Halsted (7); and Murphy (13) recognized the possibility that the presence of foreign material in the peritoneal cavity may act deleteriously, because he makes the following statements: "Many micro-organisms injected into joints without foreign bodies produce no inflammatory reaction, while the same culture injected with foreign bodies produce violent synovitis"; again: "The introduction of bacteria into the peritoneal cavity is not sufficient to produce peritonitis if the membrane be healthy and free from foreign bodies." If one accepts the view that foreign matter in some way enhances greatly the virulence of bacteria in the peritoneal cavity, it is hard to understand why the importance of its removal is not readily granted. The more I see of diffuse peritonitis, either as produced experimentally or as it occurs clinically, the more I am impressed with the fact that speed, however desirable, should not be obtained at the expense of methods that leave in the peritoneal cavity extravasated intestinal contents, countless unabsorbed bacteria, and their toxins.

As to the second point, namely, that irrigation traumatizes the peritoneum and accelerates absorption, it is probable that both contentions have no basis. It is, indeed, hard to conceive how irrigation properly carried out will traumatize the peritoneum. There is no question but that the older methods, where a hypotonic solution of simple boiled water or, even worse, a strongly irritant antiseptic was used, often along with vigorous sponging and eventration injured this delicate membrane; but when one fills the cavity and covers the intestines with warm, isotonic salt solution and is careful to avoid mechanical insult to the tissues, it would seem that there is far less tendency to "trauma" than when the intestines are exposed to the drying influence of the air. Wegner (18) has shown that exposure of the intestines to dry air is followed by a paralytic ileus and collapse of the animal, while on the other hand, the same operative procedures, with the exception that warm, moisture-laden air was passed over the intestines, were followed by no disastrous consequences. Proper technique, therefore, should cause no excessive trauma, but that trauma is conducive to increased rapidity of absorption seems open to question. If the peritoneal membrane plays the rôle of a passive filter, injury to or destruction of, the constituent cells will accelerate filtration; but if these cells possess a secretory power similar to those of the kidney, injury to them will lessen their activity. I do not contend that absorption from the peritoneal cavity is accomplished through vital activity of the cells, but the reverse has not been proved and should not be assumed.

It must be admitted that irrigation to be effective removes the greater part of the peritoneal exudate. At the onset, the exudate may be possessed of defensive properties, but is this true of it at the time of operation? Would any surgeon be willing to inject a considerable amount of the exudate from a patient suffering from a severe peritonitis into another patient with the object of conferring a passive immunity upon this second patient? It would seem that statements such as those made by Murphy and Hertzler are based upon rather faulty reasoning; impressed by the fact that this exudate originally contained phagocytes and unformed defensive products, these authors have apparently forgotten that later in the disease it teems with virulent bacteria. Moreover, as recently emphasized by Hughes (10), as the disease progressed the vitality of the phagocytes decreased and the defensive substances were replaced by bacterial toxins, so that the originally protective fluid became nothing more than a toxin-laden culture medium for the pathogenic organisms, acting like the "foreign bodies" so dreaded by these authors. It is interesting to note that Mikulicz observed an increased production of phagocytes following the introduction of salt solution into the peritoneal cavity; so that instead of decreasing the resistance of the peritoneum by robbing it of the exudate it is possible that the powers of resistance are actually heightened.

The possibility of spreading, through irrigation, virulent bacteria to uninvolved portions of the peritoneum is a point to be carefully considered. No one advocates irrigation of the uninvolved peritoneum in the presence of a definitely walled-off abscess. Even the staunchest supporter of free irrigation reserves this measure for those cases where there is reason to believe that we are dealing with a diffuse process. Since in these cases there is always at some stage more or less free fluid in the cavity, it is difficult to understand how the contact of this fluid in the cavity is limited to either the sound or diseased peritoneum. In view of this difficulty, it appears that the sterile saline can scarcely be more active in disseminating the infectious material. Either fluid is capable of carrying bacteria in suspension to distant parts of the peritoneal cavity, but the defensive powers of the tissues in these regions are sufficient to enable them to overcome the infecting organisms. Negative cultures do not prove that these regions were *uninvaded;* all that they show are that they are *uninvolved.*

What may be said in favor of the use of free irrigation with normal salt solution in appropriate cases?

First, contrary to the views that its opponents have advocated, it lessens the tendency to shock. This is accomplished by preventing

undue loss of heat through the use of a solution slightly above body temperature and also through the prevention of drying of the exposed intestines.

Second, it washes out mechanically a certain number of unabsorbed bacteria, and, at the same time, fibrin, pus, blood clot, or intestinal contents which may serve as "foreign material," facilitating the growth of the bacteria. As has been previously mentioned, Grawitz (6), Reichel (14), Waterhouse (17), and Murphy (13) have indicated the importance of such foreign matter in the genesis of infection. The three first named authors have shown that the intraperitoneal injection of aqueous suspensions of bacteria were not productive of results, while similar doses of bacteria accompanied by pus, gelatin, agar, or, especially, blood clot uniformly gave rise to a peritonitis.

Third, it serves to dilute those toxins which are not removed at the time of operation. Unless removed these must be destroyed in the tissues or eliminated unchanged, and, if one be permitted to reason by analogy, dilution will markedly lessen their injurious action. Kleiner and Meltzer (11) have shown that dilution greatly reduces the toxicity of strychnine when that drug is injected into animals; and the same principle has been shown by Hatcher (8) and his co-workers to apply to certain of the local anæsthetics. These latter experimenters found, for example, that when small, repeated doses of novocaine are injected into cats, more than twenty times the dose almost invariably fatal, when given quickly, would be survived. If dilution thus lessens the toxicity of strychnine and novocaine, it is probable that it would similarly lessen the toxicity of bacterial poisons.

Finally, the peritoneum is an absorbing surface of great activity. Attention was first directed to this by Wegner (18) and it has been emphasized by Clairmont and Haberer (3), Schnitzler and Ewald (15), and Dandy and Rowntree (14). These last named authors have shown that phenolsulphonephthalein appears in the blood within two minutes after its introduction into the peritoneal cavity of dogs, and that at the end of an hour, from 40 to 60 per cent of the injected dye had appeared in the urine. Pediatricians have recognized the value of the intraperitoneal administration of fluid, and it is now a frequent procedure in cases of infants suffering from excessive water loss.

These arguments, based upon theoretical considerations, do not, I believe, tend to show that irrigation of the peritoneal cavity in the presence of a diffuse peritonitis is a reprehensible procedure. Actual results, however, as I have already pointed out, should influence us in making a decision rather than these theoretical considerations, no matter how logical the latter may seem.

It requires the utmost caution not to be misled by clinical results. The surgeon does not employ a single procedure in the treatment of his patient and it is difficult to know which one is most active in effecting a cure. With each case, the conscientious physician is concerned primarily in effecting a cure and only secondarily with determining the efficiency of the various procedures adopted. It would seem, therefore, that by means of animal experimentation, where the conditions may be more accurately controlled and where the recovery of the animal is unimportant the most valuable information could be obtained.

The attempt to learn through animal experimentation the value of irrigation in the treatment of peritonitis has not been lacking. Reichel (14), in an excellent paper, publishes the reports of experiments which seem to indicate that irrigation is not only useless but actually does harm. Clairmont and Haberer (3) were unable to save any animals that had received a fatal dose of bacteria intraperitoneally, though irrigation was practiced in some cases within a few minutes after the injection of the organisms. They did find, however, that by means of irrigation animals could be saved from otherwise fatal doses of toxins which had been injected intraperitoneally. Witzel (19) concludes that irrigation is of value, but gives no details of his experiments. Trzebicky (16) states that irrigation was effective in saving 7 out of 18 dogs, while the control dogs all died.

During the past 15 months, I have endeavored to secure additional information as

to the probable value of irrigation in the treatment of peritonitis. In spite of the fact that I have used over 250 animals during this period, I cannot say that the question has been definitely answered.

The production of an experimental peritonitis at all comparable to the condition encountered clinically is practically impossible. Reichel (14) has emphasized this fact, declaring that there results either a comparatively mild disturbance from which the animal will recover; rapid death with no demonstrable changes in the peritoneal cavity; peritonitis with a hæmorrhagic exudate and early death; while only rarely is there seen the more prolonged peritoneal involvement found in human beings with its purulent or seropurulent exudate. These statements I have been abundantly able to confirm; as well as his observation as to the enormous variation in the resistance of different dogs. The details of these experiments will be published elsewhere; it is of interest, however, to review the results briefly.

The ideal as I saw it was to produce in dogs a peritonitis which would always cause the death of the animals unless appropriate treatment was instituted and then to ascertain the value of the two methods of treatment; namely, either rapid incision and drainage, with repair of any wound that existed, or, the use of irrigation with normal saline in sufficient amounts to wash out exudate and detritus. In the cases where irrigation was employed, drainage was seldom used; and in the cases treated without irrigation, the best results were obtained in those where drainage was omitted. This is mentioned as an interesting fact; it does not prove that the drainage was injurious or could be safely dispensed with.

It was soon found that this ideal was unobtainable. The resistance of different dogs varied to such an extent that a procedure which would cause the death of certain highly resistant animals was so rapidly fatal to the average animal as to render any treatment useless. It was necessary to be content, therefore, with a procedure which gave rise to a peritonitis fatal to the great majority of untreated dogs, and, subjecting all of the animals to this procedure, to ascertain the number of survivals in the three different series: controls, non-irrigated, and irrigated.

The attempt was first made to produce the peritonitis by injecting pure cultures of different bacteria intraperitoneally. Whether these were in bouillon or gelatin, a fatal peritonitis could scarcely ever be produced, and even the simultaneous injection of blood clot or fæcal suspension was generally unsuccessful in accomplishing this end. Recourse was next had to incision of the colon. At first, this was done by thrusting the knife through the wall of the colon, as low in the pelvis as could be conveniently reached.

The peritonitis produced in this way, however, ran a very irregular course, many of the untreated controls surviving. The inclusion of the results of these experiments here would only confuse, so an analysis of them will be withheld until the appearance of the more detailed paper. A more virulent disease was produced, however, in the following manner. The exudate removed from a dog succumbing to a fatal perforative peritonitis was injected intraperitoneally into other dogs and by successive passage, its toxicity was greatly enhanced, according to the method of Burginsky (1). If this enhancement were carried too far, the virulence became so great that all animals died regardless of the method of treatment. Many experiments were necessary, therefore, before an exudate of satisfactory strength was secured. Bacteriological examination of this exudate in three instances was kindly made by Dr. S. W. Budd, and bacillus coli was the only organism recoverable. The same finding was made in the heart blood from one dog succumbing to the infection. It is possible that other organisms were associated with the colon bacillus, but were overgrown by the latter. Five different exudates were used with fairly satisfactory results. Grouping all of these together, we found that the animals treated by irrigation had the lowest mortality rate. The results of the experiments are given below.

| Method of Treatment | Mortality |
|---|---|
| Incision and drainage | 100 per cent |
| Controls | 89.1 per cent |
| Irrigation | 78.9 per cent |

Even with a highly virulent exudate, certain of the untreated controls survived. The attempt was always made to use the animals in worst condition for irrigation, and it was found that the initial leucocyte count and its behavior following the injection of the exudate gave some information as to the prognosis. Thus, a dog with a high initial white count and responding by an increase in the leucocytes following the injection was found to be more resistant than one with a lower count and a poor response on the part of the leucocytes following the injection. When it is realized, then, that the dogs subjected to irrigation represent the poorest risks, the figures assume an added importance and speak strongly in favor of this procedure. The adoption of the "get in quickly—get out quicker" method was particularly disastrous; not only did all of the animals so treated succumb, but their duration of life was distinctly lessened. This, I am convinced, was due to the etherization, but in spite of this factor, the mortality percentage of the irrigated animals who also had ether is lower than that of the controls.

In estimating the value of the reports as to the number of recoveries following operation for diffuse peritonitis, it is necessary to know what is meant by the term "diffuse peritonitis." Unfortunately, there is lack of agreement as to what constitutes a diffuse process; one surgeon so designating a condition which a second operator will feel to be an instance of localized infection. It is to be regretted that there are no definite criteria which may be used to determine the gravity of a peritonitis as we encounter it, but the following points are certainly of much assistance in arriving at a conclusion as to this.

1. The genesis of the peritonitis; whether it arise from a stab or gunshot wound, perforated ulcer, or ruptured appendix;

2. The number of cases of "diffuse peritonitis" in proportion to the total number of acute cases seen by the surgeon;

3. The lapse of time which has occurred since the onset of the symptoms;

4. The general appearance of the patient, the character of the pulse, and the nature of the abdominal resistance; and

5. Finally, the appearance on opening the abdomen.

A very frequent cause of fatal peritonitis is a ruptured appendix or appendiceal abscess. From an examination of the mortality statistics for the state of Virginia, it would seem, from a conservative estimate, that over 500 persons died during 1919 from appendicitis. In the registration area of the United States, comprising about 75 per cent of the population, 9,941 deaths were reported as due to appendicitis during 1918, while peritonitis was responsible for 1858. Undoubtedly, many patients succumbed to peritonitis masquerading under a diagnosis of "acute gastritis," or where death occurred with no attending physician. Moreover, it is probable that the course of the disease in different patients when a common cause exists will follow more nearly similar lines than where cases due to diverse causes, such as wounds or ulcer perforations, are included. Therefore, in the present discussion of peritonitis, I shall limit myself to a consideration of those which have originated as the result of appendiceal rupture.

During the past 12½ years, there have occurred in my practice 1,031 cases of acute appendicitis. In the same period of time, we have encountered 33 cases that we considered instances of true, perforative diffuse peritonitis. Therefore, the cases of peritonitis constitute a little more than 3 per cent of the total number of acute appendix cases, a ratio which I do not believe too high when it is appreciated that 85 per cent of my practice comes from the rural districts and the patients are subjected to the usual delays, rough travel, etc.

The condition revealed on opening the abdomen is, I believe, the best guide in determining the extent of the process. Certainly, in my experience, a satisfactory examination through the small incision advocated by the supporters of the "get in quickly—get out quicker" plan is difficult or impossible.

So far as the aim of this paper is concerned, it is fortunate that my cases of peritonitis can be divided into two series. During the last [illegible] years of the period mentioned, 14 cases of peritonitis and 460 cases of acute

appendicitis were operated upon. In the past 7 years 19 cases of peritonitis and 571 cases of acute appendicitis were treated. Gastric lavage, opiates, and the free use of salt solution by rectum and subcutaneously were used in both series; indeed, the treatment in both periods were identical with one exception. In the earlier series, the principle of rapid operation with a minimum of intra-abdominal manipulation was practiced. Of the 14 patients so treated, 7 succumbed, giving a mortality of 50 per cent. The second series was made up of 19 patients, 18 of whom were treated by free incision, the opening of all pockets, and combined irrigation with normal saline and the use of a water or electric suction apparatus. The technique I employed did not cause unnecessary trauma to the peritoneum, and with the use of the suction apparatus, it was little more time-consuming than the operation where irrigation was omitted. Of the 19 patients seen, 3 died.

It is interesting to review briefly the histories of these three fatal cases.

The first, case 6, in the last series, was a girl of 16, who came to the hospital practically moribund, dying in 3 hours. Ill 10 days, she was being brought in to be operated upon for appendiceal abscess, but rupture of the abscess occurred on the train, and so rapidly was she overcome by the toxæmia that operation was refused. I have always regretted the course followed by me in this case, because, subsequently, cases apparently fully as serious, responded favorably to irrigation.

The second fatal case, case 15, of this series, occurred in a boy of 17. Ill 74 hours, severe diffuse peritonitis was revealed at operation, but he convalesced rapidly. Distention disappeared entirely, bowels moved spontaneously, and he was receiving general diet. Right-sided empyema developed on the tenth day and death occurred 4 days later.

The third case was in a boy of 12, case 19, of the series. Duration of illness was 66 hours. On entry, heart rate obtained with stethoscope was 176; temperature 99.5° F. The clinical appearance suggested overwhelming toxæmia. At operation, there was disclosed a perforated appendix and a generalized redness of the peritoneum with very little exudate. Culture revealed the presence of streptococcus. Death occurred 36 hours after operation.

Including the patient refused operation, the mortality in the series treated by irrigation was 16 per cent as compared to 50 per cent in those treated by the "get in quickly—get out quicker" method. So far as I could determine the patients in the irrigated series were fully as ill as those in the non-irrigated, and, in my hands, I am convinced that the same high mortality would have resulted had irrigation been omitted.

Aside from the reduction in mortality, I attribute to the use of irrigation a shorter and smoother convalescence and a lessening of the importance of drainage and the Fowler posture.

In the face of this evidence, is it logical to consider that irrigation is a procedure so fraught with danger to the patient? With a full realization of the adverse views held by many I wish to state that my clinical experience and many facts of animal experimentation indicate to me strongly that this measure is of value in the treatment of progressive diffuse peritonitis, and I am convinced that it enabled me to save patients who would otherwise have succumbed.

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# PAPILLARY CYSTADENOMA OF THE OVARY[1]

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PAPILLARY cystadenoma is the most important surgical disease of the ovary. The obscurity of the histogenesis, the complexity of the pathology, and the latent symptomatology of ovarian tumors have led the writers to present case records illustrative of some of the different problems relating to papillary cysts and lay a foundation for certain fundamental principles pertaining to their treatment.

As the first consideration, we are dealing with an organ which periodically develops the most complex cell in ontology—the ovum. The evolution of the ovum is attended by a cellular activity not exceeded by that of any other tissues of the body. Moreover, as the variety of cells of the ovary is greater than in any other anatomical structure, it is not surprising, therefore, that we should meet here in this fertile field of activity, the greatest varieties of cellular perversions and pathological conditions when once the normal is disturbed.

## ETIOLOGY

In a review of 5,000 consecutive pathological sections of the Pathological Department of the New York Post Graduate Medical School and Hospital, cystic disease of the ovary constituted 200 or 4 per cent, and of the 200, 36 or 18 per cent were papillary, viz.:

| | | |
|---|---|---|
| 1. | Simple cystic ovary | 112 |
| 2. | Follicular cysts | 30 |
| 3. | Cysts of the graafian follicle | 3 |
| 4. | Dermoid cysts | |
| | a. Simple | 11 |
| | b. Dermoid with serous cystoma | 1 |
| | c. Bilateral dermoid | 1 |
| 5. | Cystadenofibroma | 1 |
| 6. | Parovarian cysts | 5 |
| 7. | Papillary cystadenomata | 36 (18 per cent) |

As compared with the statistics of others, Pfannenstiel (1) finds 60 papillary cystadenomata in 400 ovarian cysts(15 per cent); Coblentz (2) states that 10 to 15 per cent of all large ovarian tumors are papiliary; Willis quoted by Gardner (3) states that of 10,290 tumors examined, 804 were ovarian in which 752 were cystic, 30 dermoids, 27 carcinoma, 24 sarcoma, and 1 fibroma; from the Mayo Clinic, MacCarty (4) reports 163 papillary cysts in 1,000 ovarian cysts; in one series of Howard Kelly (5) 30 of 138 ovarian cysts were papillary (22 per cent); and Martin and Libbert quoted by Ewing (6) found 55 papillary cystadenomata in 200 ovarian cysts (27.5 per cent). The frequency, therefore, varies according to the above observers from 10 to 27.5 per cent of all ovarian cysts. In addition to the 36 cases of the Post Graduate Hospital (many of which were patients on the service of Dr. Erdmann), statistics of 13 cases of papillary cystadenomata taken from the personal records of the senior writer, as being operated upon elsewhere than at the Post Graduate Hospital, and three from the junior writer's cases, are incorporated in this paper. These latter cases have been operated upon during the past 5 years. Observations and conclusions are, therefore, drawn from 52 cases.

In 44 of the 52 cases, the ages ranged as follows:

| | Cases |
|---|---|
| 21 to 30 | 11 |
| 31 to 40 | 6 |
| 41 to 50 | 17 |
| 51 to 60 | 5 |
| 61 to 65 | 4 |
| 74 | 1 |

Twenty-two of these cases are recorded as having had children and we concur with Kelly (*loc. cit.*) in believing that there is no reason to conclude that childbirth has any bearing on the causation of ovarian cysts.

## HISTOGENESIS

Nothing in ovarian literature is more confusing than the histogenesis of cysts, particularly the papillary. Every embryological and

[1] A contribution from the Surgical Department of the New York Post Graduate Medical School and Hospital. Read before the Obstetrical and Gynecological Section of the New York Academy of Medicine, March 22, 1921

histological structure has contributed a theory of origin, and considering, therefore, the number of structures from which the ovarian tumors might arise, and the confusing multiplicity of views, no definite conclusion as to the exact histogenesis has yet been reached.

The first observations of papillary cysts were made by Hodgkin (7) in 1829, but no explanation of their origin was made until 1848 when Virchow (8) stated that the graafian follicle was only responsible for small cysts and showed that the proliferating cystomata were developed from a colloid degeneration of the ovarian stroma. Shortly afterward (1855) this theory was upheld by Rokitansky (9) who called them villous cancers. A few years later Vogel and Wedl (10) regarded cysts as spaces formed in the alveolar tissue either pre-existing or of new formation, which spaces became filled with fluid either from serous effusion or fibrinous exudation and subsequently became encapsulated by denser layers of areolar tissues while an endogenous formation of epithelium took place on their inner wall. Wilson Fox (12), in 1864, pretty clearly proved that many cysts were formed by the union of the papillary branches but believed that all forms of cysts could be derived from the graafian follicle. This theory was confirmed by Mayweg (13) in 1868.

With the appearance of Waldeyer's (14) remarkable treatise (1870) based on the anatomy and development of the ovary, the pathology of ovarian diseases was put on a scientific basis. In the histogenesis of ovarian cysts, he radically departed from the earlier conflicting views, demonstrating that the cystomata were derived from Pflueger's tubes, which he believed either to be fœtal remnants or newly formed elements in the adult. He classified them as glandular and papillary—the former, the result of epithelial activity with the production of adenomatous tissue, and the latter, resulting from the actively proliferating, vascular, connective-tissue stroma growing more abundantly and pushing out the lining epithelium, producing papillary trees. In 1877, Olshausen (15) was the first to draw a sharp line of distinction between the papillary and glandular cystadenomata. He pointed out that as many papillary growths show the presence of ciliated epithelium, they must be derived from the parovarian elements, but when Marchand's (16) theory that all ovarian tumors were derived from the germinal epithelium was advanced in 1878, he (Olshausen) abandoned his parovarian theory in favor of the germinal epithelium. Noeggerath (17, 1880) believed in the angiomatous genesis of ovarian cysts. In 1881 Doran (18) found a proliferating ovarian cyst in a 7 months fœtus and from the studies in this case concluded that ovarian cysts were derived from the wolffian bodies.

In 1893 Williams (19) very ably reviewed the entire literature on the subject and substantiated the view of Marchand and Olshausen. He concluded that papillary growths are either derived from the graafian follicle or germinal epithelium and that their origin from the wolffian bodies or from the tubular epithelium, while possible, has yet to be proved. In support of the graafian theory, he presents a microscopical section which clearly shows a papillary projection developing from the inner surface of a graafian follicle. Pfannenstiel, Ewing, Hertzler, Adami, and others accept the germinal epithelium, wolffian body, graafian follicle, and Pflueger tube theories.

In a recent masterly article by Goodall (20) a new theory of histogenesis is advanced. His work is based upon a comparative study of 15,000 sections, serial and non-serial, of 127 humans of all ages including 5 human embryos and many animal embryos. He states that the ovary contains two distinct types of cells, the interstitial cell allied to and originating from the germinal epithelium, and capable of transformation of form and endowed with secretory function, and the connective-tissue cell proper derived from the connective tissue of the wolffian body. The former possesses much of the potentiality of the oogenic tissue; the latter is but a supporting structure. He believes that all epithelial structures within the ovary are derived from a common source—the germinal epithelium. Excluding the condition which is commonly known as hydrops folliculi, he says with every emphasis that he does not believe that tumors can arise from the graafian follicle in the process of development

and degeneration and moreover that there is not one case in the literature of a graafian follicle that is supposed to show developing papillæ that will stand the test of scientific criticism.

With this confusing array of theories, the histogenesis becomes one of the most complex of problems. In the preceding two decades, most authorities have accepted the germinal epithelium as the most probable source of ovarian tumors, and certainly so, when it is realized that no epithelial tissue in the body has the cellular activity equal to these germinal cells. Only when one considers, moreover, the vascular sensitiveness of the ovary and the frequency of chronic irritational lesions contingent upon sexual impulses, parturition, and upon all the pathological conditions which lead to hyperæmia, can the special liability of the ovary to proliferative changes and cyst formation be realized. There is no human organ where the transition from the normal to the pathological state is so faintly marked as in this complex body. Papillary disease is unquestionably a distinct entity and while papillary formations are most likely to be associated with or attack, if the term may be used, unilocular serous cysts, it is frequently associated with the pseudomucinous variety, parovarian cysts, and many record its occurrence on the inner surface of the graafian follicle or associated with tubo-ovarian cysts. Pfannenstiel found papillary growths in 3 of 48 parovarian tumors, and in two cases of enlarged graafian follicles found low warty papillæ.

PATHOLOGY

In the Post Graduate Hospital series, 18 per cent of the ovarian cystomata were papillary in type. The relation which the papillomatous variety holds in ovarian pathology is perhaps most clearly shown by Hertzler (21):

1. Retention cysts
   1. Luteal cysts
   2. Follicular cysts

   formed by disturbance of the evolution of normal processes. Not neoplastic.
      a. Graafian follicle cyst
      b. Multiple cystic degeneration
      c. Tubo-ovarian cysts
2. Proliferating cysts
   1. Simple
      The epithelium takes an active part in the growth of the tumor but the chief activity is manifest in an increased secretion. Not neoplastic.
   2. Adenomatous
      Epithelial proliferation is in excess of that required to line cyst walls. True neoplasm.
      a. Pseudomucinous
         1. Everting (glandular). Cells form new cysts within the wall of the mother cyst.
         2. Inverting (papillary). Cells form projections into the cyst cavity.
      b. Serous.
         1. Everting (glandular).
         2. Inverting (papillary).

In the early stages the capsule of the papillary cystadenoma of the serous type is firm, smooth, and usually thin, and later when the cells proliferate and penetrate into the capsule, it becomes friable and rough. This type does not, as a rule, attain great size, because of the tendency of the papillæ to infiltrate and perforate the wall, and conversely Olshausen has pointed out that the larger the cyst, the less liable to papillations. Bland-Sutton's case (22), however, of a 70 pound tumor proves the rare exception to this rule. Kelly (*loc. cit.*) states that in one-third of the cases papillary cysts appear superficially on the external surface of the ovary. The gross examination of the unruptured cysts will give no evidence of its papillary nature.

On section, however, a soft, friable, papillary mass which bleeds readily on handling is noted. It varies in size from a small warty growth to a mass which sometimes crowds the entire cavity, resembling a solid tumor. Many secondary cysts are usually in evidence, each containing a papillary or warty deposit. The papillary growths are vascular and vary in color depending upon the amount of blood supply—the actively proliferating projections appear pinkish; in the event of enormous cellular activity in which the cysts become filled with the papillary projections, they often show signs of fatty or calcific degeneration and appear yellowish; and greyish or even black if necrotic. Calcific changes occur either as large plaques as in arterial or cardiac calcification, lining the cyst wall, or as large solid masses composing part of the base of the growth or as small gritty deposits along the papillæ known as psammonous bodies. The first two are degenerative changes while the sandy granules are claimed by Pfannenstiel to be a biologic process, the result of excessive nutrition. The papillary prolifera-

tion may be so extreme that the whole cyst becomes filled with a soft semigelatinous growth. One often notes in the same tumor various gradations of growth in the various loculi ranging from the simple warty deposits to typical areas of malignancy. When the cellular proliferation is very abundant the solid growth bursts through the wall. The growth of the papillary processes may so exceed that of the cyst wall that it gradually disappears and can only be discovered after a close search as a thin ring about the base of the papillary mass. Occasionally perforation of the cyst wall may take place into the adjacent organs instead of into the peritoneal cavity, and the papillary masses may then protrude into the bladder, rectum, uterus, or as the case of Grad's (23) into the vagina, and present externally.

The following two cases taken from Dr. Erdmann's personal records presented vaginal perforation and infiltration:

No. 884.1910. Mrs. D., age 50, was admitted to the Roosevelt Hospital for an advanced papillary peritonitis. Malignant cysts presented on vaginal examination and the diagnosis was obvious. The patient gave a history strongly suggestive of traumatic rupture of the cysts some weeks previous to hospital treatment. Laparotomy revealed bilateral masses fully as large as cocoanuts, of the encephaloid type, filling the pelvis. The peritoneum was completely studded with warts. Dr. Sondern reported highly malignant findings. Patient died a few days after operation.

No. 471, 1917. Mrs. K., widow, age 50, admitted to the Flower Hospital for abdominal masses. Bimanual examination presented extensive vaginal infiltration. Laparotomy revealed bilateral ovarian involvement with general abdominal carcinomatosis and erosion of uterus and vagina. Patient lived 10 months after operation.

Rupture is caused by pressure of the epithelial proliferation and the cellular secretion from within associated with fatty degeneration or atrophy of the cyst wall. The peritoneum becomes contaminated with papillary fragments, and if there is considerable fluid in the cyst at the time of rupture, the peristaltic action will carry the implants even as high as the diaphragm. Ascites occurs with rupture and the case is then clinically in an advanced stage. Three patients presenting rupture in large advanced tumors complicated with general peritonitis were operated upon by the senior writer in this past year.

The fluid in the cysts is the result of epithelial secretion. Rokitansky (*loc. cit.*) considers the papillæ as equivalent to everted crypts or follicles. It is usually serous but may be viscid or almost gelatinous, alkaline, usually clear straw-colored, and with a low specific gravity. Dependent upon the amount of hæmorrhage and cellular exudation, the fluid is discolored or turbid with a consequent increase in the specific gravity. The quantity secreted may be enormous. Pye-Smith's (24) case was tapped 299 times in 10 years for hydroperitoneum. She died on the three hundredth tapping and a postmortem showed an extensive peritoneal involvement and bilateral ovarian papillary cysts which could easily have been removed by operation.

Case 20, 1917, of Dr. Erdmann's records presents the following unusual, postoperative serous drainage:

Miss L., age 25, admitted to the Roosevelt Hospital for the removal of bilateral cauliflower ovarian masses which proved to be highly malignant, papillary cysts. The peritoneum was extensively infiltrated. Following removal of all possible implants the abdomen was drained. The drainage was so profuse that three or four very large daily dressings were not sufficient. The patient became gradually depleted from the inconceivable serum losses without responding to transfusions or saline infusions and died of exhaustion within 8 days.

At its inception, a papillary projection (Figs. 1 to 4) is developed by a proliferation of the epithelium and as it pushes out from the surface, the subjacent connective tissue follows it, carrying the capillary and lymph vessels. On section this is composed of a layer of cells surrounding a core of vascularized connective tissue. Secondary growths of the epithelium and stroma give rise to the more complex papillary trees and on cross section a very bizarre microscopical appearance may then present (Figs. 5 and 6).

The microscopical section (Fig. 2) shows one or more layers of cuboidal or columnar epithelium ciliated or non-ciliated. Williams (*loc. cit.*) states that when ciliated cells occur, they are found on the papillary epithelium and not on the epithelium lining the cyst wall. He believes their presence or absence is purely

accidental and consequently a matter of indifference. In some microscopical sections the epithelial cells become large and hyperplastic and show frequent mitotic figures. The tendency of the cells to hyperplasia, mitosis, and atypical growth and staining characteristics constitute the transition toward malignancy (Figs. 5 and 6). In other sections the cross section of the papillæ shows large atypical, highly pyknotic, and mitotic cells invading the scanty connective-stissue stroma in almost lawless manner. These are malignant (Figs. 7 and 8).

A review of a series of papillary sections impresses one with two facts: The very gradual transition, with no sharp line of distinction or classification from the benign to the premalignant and to the typically carcinomatous picture; and that a simple, apparently benign papillary area may exist in the same section with a complex or malignant field, from which clinically one can only conclude that there is no clinical method whereby the degree of malignancy can be determined except by the microscope. The last word, therefore, is that of the pathologist.

### MALIGNANCY

Neoplastically, this type of papilloma is considered histologically benign by Pfannenstiel. Yet, the old platitude holds true that "there are papillomata and papillomata." What the stimulus is which adds the malignant taint, so to speak, is, of course, yet to be determined, but it is of no practical importance whether a papillary cyst is malignant from its inception or the malignant element be added to an originally benign process.

In the 36 Post Graduate Hospital cases above cited, microscopical examination leads us to classify them as follows:

| | Unilateral | Bilateral |
|---|---|---|
| Unilocular | | |
| Benign | 5 | 1 |
| Premalignant | 4 | 1 |
| Malignant | 13 | 4 |
| Multilocular | | |
| Benign | 1 | 1 |
| Premalignant | 1 | |
| Malignant | | 1 |

This table indicates that 33 per cent were benign, 16.6 per cent premalignant, and 50 per cent malignant; 22.2 per cent were bilateral, and 13.8 per cent multilocular. Therefore out of 200 cases of all types of ovarian tumors, 12 per cent were malignant or premalignant papillomata.

In the 12 cases in which the age is stated, malignancy is noted as follows:

| | Cases |
|---|---|
| 21 to 30 | 3 |
| 31 to 40 | 4 |
| 41 to 50 | 2 |
| 51 to 60 | 1 |
| 61 to 65 | 2 |

Olshausen's statistics (quoting Haury, 25) show that 15 per cent of all ovarian tumors are primarily or secondarily malignant; Schroeder 16 per cent; Fritsch 18 percent; Leopold 23 per cent; Kelly 8 per cent; Freund 21 per cent; Werder 25.3 per cent; the Pennsylvania Hospital 15.3 per cent. Shauta claims that 20 per cent are malignant and 20 per cent premalignant in a series of 200 cases of ovarian cysts. Martin and Libbert (quoted by Ewing) show that 22 percent were carcinomatous.

Foulis (26) in 1875 was one of the first to point out the development of malignant peritonitis from the escape of the epithelial elements of a papillary cyst into the peritoneal cavity. The advent of malignancy is usually noted by an infiltration at the pedicle. The cyst has usually been ruptured and a large cauliflower mass presents with extensive peritoneal implants and adhesions. The base is often necrotic, infiltrated with calcium salts, and there are areas of yellowish white carcinomatous tissue. Those rich in glandular tissue favor malignancy. Histologically and clinically the transition from the benign through the various degrees to malignancy is imperceptible. The cells of malignancy are larger, pyknotic, show many mitotic figures, are atypical in arrangement, and invade the surrounding tissues (Figs. 7 and 8).

Every warty or papillary intracystic deposit and every secondary cyst, however small, should be sectioned for malignancy. It is often surprising to learn that a small secondary cyst contains extremely malignant papillary elements:

In a recent case operated upon by the senior writer the ovarian tumor 12 by 9 by 7 centimeters contained three small cysts 10 by 20 millimeters. Each was filled with papillary material which microscopically proved to be carcinomatous.

Fig. 1. Section No. 2030. Simple papilla showing single layer of cuboidal and columnar epithelial cells surrounding vascularized connective tissue core.

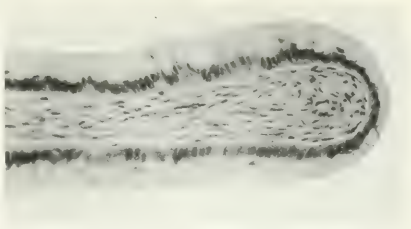

Fig. 2. Higher magnification of Figure 1

In many benign processes, an extensive papillary peritonitis is seen. The benignity of the process is proved only when the peritoneal warts have disappeared when a laparotomy is performed subsequent to the primary ovariotomy. Hoffmeier (mentioned by Codman, 27) gives the report of the disappearance or retrogression of a true adenocarcinoma. This is most exceptional, however. Yet in this connection the following unusual case is noted:

Mrs.—, age about 50, (Dr. Erdmann's case No. 731, 1914) was operated upon by a reliable surgeon but noting the extensive peritoneal metastasis he closed the abdomen at once, and told her husband the growth could not be removed. Her dysuria and frequent urination became so intolerable she insisted upon re-operation. She was admitted to the Post Graduate Hospital 6 months after the first operation and two ovarian papillary masses, each the size of a large grapefruit were removed, The entire pelvis was extensively involved. As careful "toilette" of the peritoneum as possible was made, and the wound was closed without drainage. She made an uneventful but slow recovery and from the last report, she is in excellent health today—and without bladder symptoms. This operation was four and a half years ago.

### BILATERALISM AND METASTASIS

Any of the bilateral organs—the eyes, ears, lungs, breasts, kidneys, ovaries, and tubes—are prone to undergo similar pathological changes, performing, as they do, the same functions and subjected for anatomical and physiological reasons to the same congestions, toxæmias, infections, etc. This bilateral tendency is as true in the benign microcystic ovarian degeneration as it is in malignant changes. As early as 1829, Hodgkin remarked the frequency of "double ovarian dropsy" (*loc. cit.*) and Rokitansky (*loc. cit.*), among other early pathologists, noted the great tendency to bilateralism in ovarian diseases. Twenty-three per cent of Kelly's (*loc. cit.*) cases were bilateral. Pfannenstiel's figures show that out of 400 ovariotomies, he found 60 papillary cysts of which 29 were bilateral. Williams (*loc. cit.*) says that nearly half the cases are bilateral. Ewing (*loc. cit.*) states that the active papillary forms effect both ovaries in 60 per cent of the cases either as primary tumors or through implantation. In the cases taken from the Pathological Department of the New York Post Graduate Hospital, 22.2 per cent of the papillary growths were bilateral, although a greater frequency exists in the individual work of the senior writer.

Bilateralism, especially as related to the solid forms of ovarian tumors, usually indicates a carcinomatous process elsewhere in the body—the stomach, breast, intestines, or gall-bladder. Stone (28) has collected 133 cases of the so-called Krukenberg's tumor (fibrosarcoma ovarii mucocellulare, carcinomatodes) from the literature and found a primary focus in the stomach in 75 cases, 25 in the breast, 22 in the large intestine, 5 in the gall-bladder, 4 in the small intestine, 1 in the pancreas, and 1 in the appendix. Bland-Sutton (*loc. cit.*) states that there is a massive deposit in both ovaries in 10 percent of the autopsies after gastric or mammary cancer.

Fig. 3. Section No. 2032, showing simple papillary projections on septum between two cysts.

Fig. 4. Same as Figure 3, higher magnification. Note well defined basement membrane.

Symmetrical involvement in papillary cysts is often not in evidence at the time of operation, and many surgeons have felt they have satisfied all the surgical indications in cases which on subsequent laparotomy show the ovary, considered apparently normal at the first operation, has become affected with papillary growths.

One of the junior writer's cases (Frances McG., married, age 24, nullipara) was admitted to the hospital February 4, 1919, with a history of profuse flowing for a period of 28 days preceded by a slight vaginal discharge but burning was not associated with urination.

Pelvic examination revealed evidence of an acute salpingitis. Two weeks later she was laparotomized, the tubes were removed, and a pelvic abscess drained. At this operation both ovaries were apparently normal. The following June, she began to have pain referable to the right lower abdomen and a mass presented itself bimanually. Her appendix had been removed 5 years previously, and the mass was quite obviously an ovarian cyst. This was removed July 22, 1919, the gross and microscopical section showing its papillary nature. She continued to have colicky abdominal pains from the time she was allowed out of bed. These pains were more pronounced after eating, her abdomen became somewhat distended, and she suffered constipation. She was re-operated upon, September 9, 1919, and omental adhesions which had caused a chronic intestinal obstruction were removed. She was apparently well until January when she began to complain of the same symptoms of adhesions. Operation March 23, 1920, disclosed an ovarian cyst the size of a fist. This cyst on section revealed the typical papillary character as did the right ovary. Since her artificial menopause she has gained 22 pounds and appears to be in splendid health, without the discomfort of vascular symptoms.

This case shows the bilateral tendency of the papillary type, the apparently normal ovary on the left side at the time the right was removed and the rapidity of the growth of the left ovary to the size of a fist, the left ovary being removed 8 months later. Silhol (29) reports a similar case of unilateral oophorectomy for papillary cysts and 7 years later the other ovary was removed for the same cause.

Metastasis takes place through the retroperitoneal lymphatic spaces by permeation or retrograde transportation, or by peritoneal implantations in which the fragments drop down from tumors in the upper parts of the abdomen. The endothelial cell lining of the peritoneal cavity or in fact any serous surface has a great intrinsic resistance to infection and moreover is not so frequently the source of neoplastic activity as the glandular or epithelial structures. When, therefore, it is considered that the epithelial surface of the ovary is the only "foreign cell" in the peritoneal sac, it is not unusual that neoplastic "cell droppings" from organs above should find encouragement in ovarian soil. However, it would seem to us that one of the most common causes of symmetrical involvement of the ovary, especially in papillary disease, is actual contact. How often are the ovaries with long pedicles found in apposition in the cul-de-sac and yet when the pathological process progresses, the pedicle through inflammation or infiltration retracts.

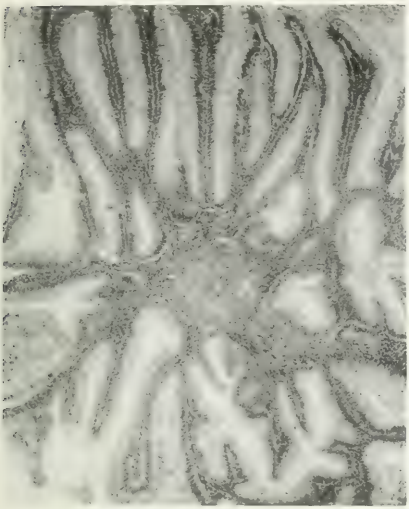

Fig. 5. Section No. 3286. Papillary cystadenoma showing carcinomatous transition. Note bizarre anastomosing and ramifying papillæ, scant stroma, large cylindrical cells, deeply staining nuclei, and occasional mitotic figures.

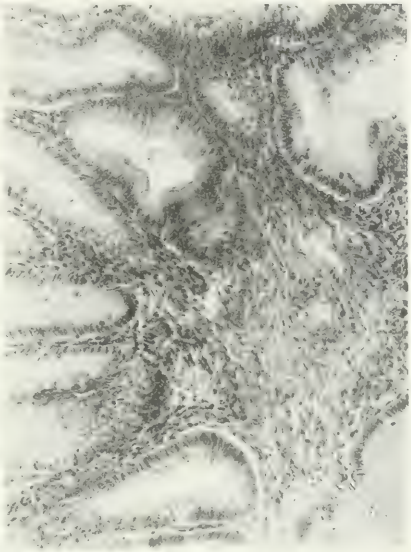

Fig. 6. Same as Figure 5, higher magnification. Note hyperplasia, atypical cells, and mitosis.

General metastasis of papillary disease while rare is met with more frequently than the literature would indicate. Wagner's case in 1863 as quoted at length by Williams (*loc cit.*) is probably the first on record—the woman aged 48 had been tapped 82 times over a period of 10 years on account of an ovarian tumor and at autopsy following pneumonia, papillary metastases were found in the chest wall, left flank, and right axilla, the latter two, the size of a fist. Wilkes and Moxon (30) give an autopsy record of the case of a woman, aged 60, with papillary metastases in the lungs and liver. J. Vance (31) reports an intraligamentous multiple papillary cyst with metastasis in the chest in which the microscopical examination of the metastasis showed adenocarcinoma of the ovarian type. Bland-Sutton (*loc. cit.*) reports a remarkabe case of a woman aged 56, in whom he removed bilateral papillary cysts and the uterus. There was an abundant hydroperitoneum. Six years afterward he removed a tumor the size of a big plum from the right side of the sternum on the level with the second intercostal space. On gross examination, the tumor contained soft papillomata exactly like those found in the primary cysts The growth at the sternum quickly recurred and the whole manubrium was eroded by it. When she died, the large recurrent mass filled the superior mediastinum and the upper part of the right half of the thorax. There was no evidence of recurrence in the belly.

The senior writer's cases No. 741, 1919, and Mrs. S., show varying intervals of metastasis following operation:

Mrs. W., age 41, operated upon in 1918 for intestinal obstruction caused by abdominal tumors. The history and physical examination were not particularly indicative of papillary disease. On laparotomy the obstruction was found to be due to an extensive papillary peritonitis with adhesions One large, cauliflower ovarian tumor and as much of the peritoneal deposit as possible were removed and the intestinal kink relieved. In spite of the rather profuse hæmorrhage, she made a prompt recovery.

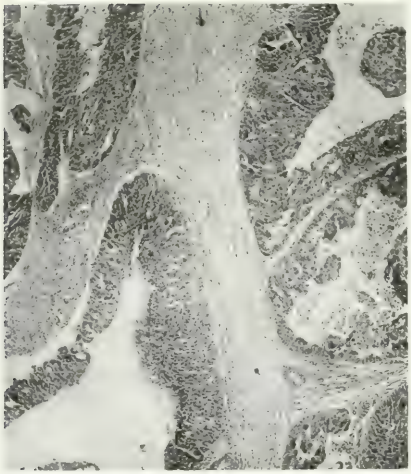

Fig. 7. Section No. 4871. Papillary cystadenocarcinoma. Massive epithelial growths and beginning infiltration of fibrous stroma.

Fourteen months later she was re-operated upon for an extensive metastasis in the abdominal wound. The peritoneum was filled with bleeding papillary masses and inoperable. She died 8 months after the second operation.

Mrs. S. (No. 141, 1907, to be recorded later) had her original operation for papillary disease at the age of 62 and metastasis developed in the abdominal scar 12 years later.

### PATHOGENESIS

Little or nothing can be said about the pathogenesis of papillary disease, but many interesting observations have been made. Multiple papillæ of the skin are in all probability infectious in nature; certainly are the genital warts complicating gonorrhœa. Although we do not know the casual agent, it is interesting, judging from the clinical and microscopical similarities of the two lesions, to speculate as to an infectious theory relative to papillary disease. Our case of Frances McG. developed a papillary process in both ovaries shortly following a gonorrhœal salpyngectomy. The anatomical position of the ovaries, one at the cæcal cistern, the other at the sigmoid cesspool and both in close proximity to the frequently infected tubal orifices favors the chronic ovarian irritation by the bacteria or their toxins which are continually seeping through.

Parasitic irritation as the causal agent is seen most strikingly in coccidiosis of the rabbit and bilharziasis of man. The former shows a papillary proliferation of the lining membrane of the bile-ducts. The structure is typically papillary cystadenomatous and the causal agent, the ova, are present in great numbers. In the latter, the presence of the ova of the bilharzia in the rectum and bladder gives rise to a papillary hyperplasia of the mucosa scarcely to be distinguished from a true adenoma; moreover these conditions may gradually become carcinomatous.

### SYMPTOMS

There is no specific ovarian symptomatology. The subjective symptoms are in every case referable to other organs and the objective symptoms are vague, uncertain, and often absent. The symptoms are dependent largely upon the size of the tumor and whether or not rupture or pedicular tortion has occurred.

Before rupture, papillary cysts can not be diagnosed as such, either by subjective symptoms or bimanually. The progressive development is so gradual—3 to 15 years Ewing (*loc. cit.*) states—that a cyst may attain a surprising size before being noticed by the patient, and even then give rise to practically no symptoms. Rapidity of growth, however, was noted in the above cited case of Frances McG. Ascites rarely if ever develops until papillary implants contaminate the peritoneum following the rupture of the cyst. Papillary cysts never attain the size of the multilocular pseudomucinous type, because rupture occurs early due to the erosion of the cyst wall by the papillæ.

The accumulation of fluid in the peritoneum, therefore, and its accompanying symptoms are among the first signs noted by the patient. Grad (*loc. cit.*) noted ascites in 27 per cent of his cases. The ascitic fluid is due to exudation, cellular secretion, and transudation due to vascular changes in the ovarian pedicle. When the papillary fragments are implanted, there is a natural protective peritoneal reaction resulting in an

exudation of fluid analogous to the exudate in tubercular peritonitis. Lymphatic absorption of the fluid may also be prevented by the mechanical blocking of the peritoneal stomata. A great part of the fluid can be accounted for by the fact that there is a constant secretion from the epithelial cells forming the papillary projections. This would be the more liable to cause a peritoneal reaction if the secretion were in any way chemically or toxically irritating—and it is natural to conclude that the secretion of atypical cells is irritating. In other cases the fluid seems to be a transudate from vascular construction of the pedicle because there are cases in which the peritoneum is thoroughly studded with warts which appear to have no reaccumulation of fluid after ovariotomy. Ascites can no doubt be best explained as a combination of these factors and in any given case it is impossible to determine which is the most dominant.

While ascites indicates rupture, yet many cases of rupture are met with which show an accumulation of fluid too small to be satisfactorily detected by physical examination, but in these cases the peritoneal implants are usually limited to a small area. The accumulation of a large quantity does not necessarily argue in favor of malignancy although it is more liable to be malignant than benign. It usually indicates a condition of a more extensive peritoneal or omental implantation which, of course, is more common in an actively spreading neoplastic condition.

Considering, therefore, the pathology of ovarian ascites, the first symptom is usually related to the effects of the pressure. Some patients merely present themselves to the physician for abdominal enlargement. As the abdomen gradually enlarges, there is a sensation of fullness, particularly noted after eating, and perhaps a little flatulence and nausea. Vomiting, however, is rare. Weight in the pelvis, difficulty in deep breathing, and frequent urination are among the early symptoms. As the fluid increases, emaciation of the extremities is noted, yet the patient loses no weight. If the tumor be large and not ruptured, there is rarely ascites and the pressure symptoms vary from that of ascites—pressure on the bladder, rectum, uterus, and veins give

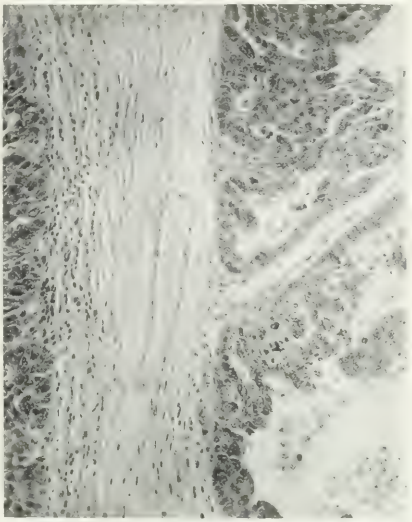

Fig. 8. Same as Figure 7, higher magnification. Note large, atypical, highly pyknotic and mitotic cells, and beginning stroma infiltration.

varying symptoms dependent upon the location and mobility of the cystic mass, namely, frequency of urination, constipation, œdema of one or both legs, hydronephrosis, etc. The occasional patient complains of a sharp, dragging pain or weight in the pelvis, but as a rule the entire course of the disease is unfortunately unattended by pain. The absence of symptoms referable to the pelvic organs is a deceptive feature of the disease. Amenorrhœa, metrorrhagia, or menorrhagia are noted in some cases; the former indicates ovarian destruction and the latter ovarian overgrowth.

The chief objective symptom is the presence of ascites which is readily determined by physical examination. If the ascites is in considerable quantity the bimanual findings are obscured. In many cases of marked enlargement, the bimanual examination is entirely negative, but in the event of paracentesis, the true cause of the ascites is very often found in the fornices or cul-de-sac. Bimanual examination often discloses irregular masses in one or both fornices. Papillary masses may be

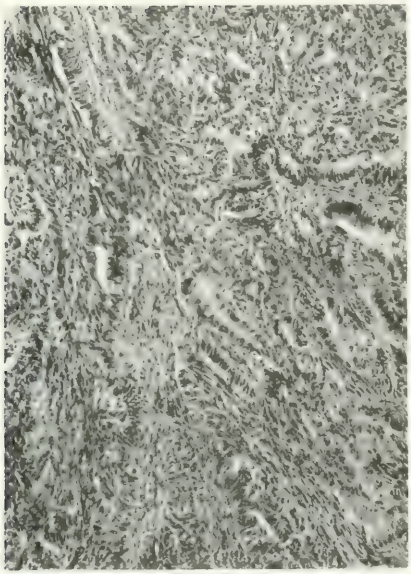

Fig. 9. Advanced adenocarcinoma sectioned from an ovarian papillary cyst.

felt in the cul-de-sac per rectum. Hydrothorax is not due to pleural metastasis but appears to be merely an extension of the ascites. We have not found it an important or frequent symptom. The symptoms consequent upon tortion of the pedicle naturally do not vary with other forms of ovarian tumor.

Papillary cysts are particularly prone to become cancerous but clinically there is nothing to suggest malignancy for a long time. In the event of malignancy, however, both the size of the abdomen and the emaciation generally increase. Either form of menstrual irregularity may be noted in malignancy. Many cases show marked cachexia and asthenia. These are apparently malignant from the beginning.

DIAGNOSIS

The diagnosis of papillary cystadenomata is difficult in the unruptured state, is at times very uncertain after rupture, and is only positive in the rare instances when the papillary masses are palpable or visible in the vagina. The small adherent monocystic ovarian tumors are more liable to be papillary than the large movable and polycystic (glandular) masses. Bilateral masses are even more open to suspicion. Hydroperitoneum without a sufficient explanation in the liver, heart, peritoneum, and kidneys is most suspicious of the existence of the papillary peritonitis even though bimanual examination be negative. In a recent case of ascites, the downward bulging of the pelvic floor made bimanual examination practically negative, yet after paracentesis both fornices plainly showed boggy, irregular, indurated masses. Rectal examination is more reliable than vaginal in determining papillary implants in Douglas' cul-de-sac.

Therefore, in the presence of ascites, pelvic masses are most probably papillomatous, particularly if bilateral. Rapidity of growth, nutritional decline, and marked weakness are indicative of malignant changes.

PROGNOSIS

The prognosis is variable. However, one must bear in mind that the papilla *per se* implanted upon or invading the surrounding tissues or organs is never, in the true clinical acceptance of the word, benign. On the other hand it rarely shows the rapid progress of neoplasms associated with other glandular or structural tissues. As shown by the critical examination of a series of microscopical sections, many typical papillary sections have a carcinomatous process developing at the same time and microscopically 66.6 per cent of the cases of the New York Post Graduate Hospital were malignant or potentially so. Many of the patients are prone to live a variable number of years after operation and have been operated upon from two to five times in a period of 10 years. The following (previously mentioned) case of the senior writer illustrates the slow progress of an adenocarcinomatous process in an elderly woman:

Mrs. S., age [illegible], No. [illegible], was operated upon for bilateral papillary disease. The ovarian masses were removed but considerable peritoneal deposit remained. The pathologist reported, "ovarian

papillary adenocarcinoma." In 1919 (12 years later) she returned for re-operation for an extensive malignant peritonitis and a metastasis in the abdominal scar.

As in other forms of neoplastic disease we believe that the age of incidence has a direct bearing on the course of the disease. Compare, for instance, the fulminating course of Miss L., Case 20, 1917, age 25, with the above patient who had an adenocarcinomatous process at the age of 62 and lived 12 years.

Schwartz (32) quotes Landau [1] that of 57 cases, 10 were well after 10 years, and O. Hohene [2] that of 34 cases, 18 were well after 5 years; Tuffier, 81 per cent were alive after 5 years; and that of Schwartz and Pollack's cases, one of the reported 11 was well after 11 years, 3 after 4 years, and the remaining 7 died in the hospital, 4 within 6 months. Hoffmeier (quoting Codman, *loc. cit.*, from Pfannenstiel) reports the disappearance or retrogression of a case of true adenocarcinoma, while Bland-Sutton says: "It has been clearly established that when an abdomen is opened for the removal of a papillary cyst and its peritoneum has been found studded with warts, a few years later the abdomen has been opened and all the peritoneal warts have disappeared." J. Knowsley Thornton's (33) case of a papillary cyst with peritoneal metastasis lived 9 years up to the publication of its report He is quoted by Williams as saying that "there are indeed some cases in which a mere exploratory incision followed by a careful 'toilette' of the peritoneal cavity leads to an absolute cure just as in the case of tubercular peritonitis." Codman's (*loc. cit.*) report of the Massachusetts General Hospital's 41 cases in the past 25 years, shows that all but 2 of the 41 died of the disease; and of 31, 12 died in less than 2 months after operation, 19 less than 6 months, and 29 less than 1 year.

Certain conclusions, however, can be drawn with reference to the prognosis; when a cyst is removed intact without peritoneal contamination, it loses its prognostic interest, howsoever malignant the pathologist may report it later; there is always that indeterminate personal equation which cannot be solved by the prognoses in other cases; prognosis as to recurrence improves with the age of incidence; in a certain number of cases where rupture has occurred and the peritoneum is abundantly studded with warts, ovariotomy has proved a sufficient therapeutic measure to cause a regression of the remaining irremovable peritoneal deposits. We feel, however, that this is quite exceptional and while they may linger on for a number of years, yet will they finally succumb to the toxic exhaustion of the malignant peritonitis. In reviewing our experience with these cases, we consider papillary ovarian tumors as potentially malignant and if ruptured usually eventuate in malignancy. In adenocarcinoma the recurrence is probable and mortality high.

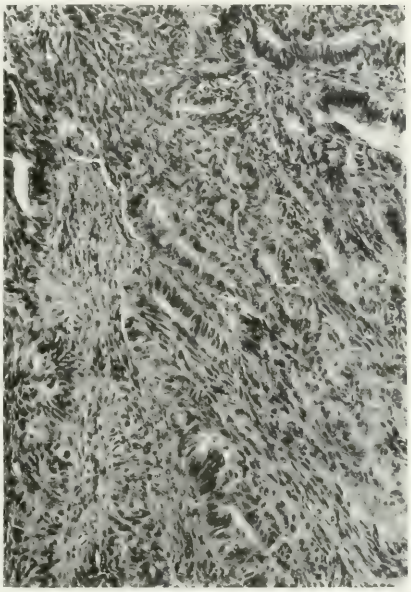

Fig. 10. Same as Figure 9, higher magnification

### TREATMENT

With a fundamental knowledge of the pathology of any given region, the principles of treatment should be simple. Every ovarian

[1] Deutsche med. Wchnschr., 1896, li, 1501.

[2] Ztschr. f. Geburtsh. u. Gynaek., 1894, lxxvi, 28

tumor should be removed as soon as diagnosed —the smallest and simplest appearing may be papillary or carcinomatous. J. Knowsley Thornton (34) in 1875 was the first to point out that as long as the villous epithelium was confined to the interior of the cyst of an ovarian tumor, it is not of much importance pathologically, except as an indication that the removal should not be too long delayed.

In the unruptured state the cyst must be removed intact regardless of the length of the incision required for its delivery *in toto*, as there is no way of distinguishing the benign adenoma from the adenocarcinoma except by microscopical section after its removal. The cyst wall is the thin dividing edge of malignancy, and of all neoplastic growths we are the most favored in the ovarian variety of tumors by this natural wall of separation between health and disease. The adhesions are separated and the cyst is liberated with all gentleness. Careless manipulation resulting in rupture within the peritoneum can not be too highly condemned. Regardless of the size of the tumor, we do not reduce by tapping, bearing in mind that even these large glandular pseudomucinous tumors are often studded with papillary growths. The fluid contents of the cysts rich in desquamated epithelial elements, must, under no circumstances, contaminate the peritoneum. The vaginal route should never be attempted in the removal of an ovarian tumor.

In the ruptured state, paracentesis alone is of little or no value in influencing the course of the disease, and has long since been discarded as a therapeutic measure. On laparotomy the fluid is evacuated and the peritoneum inspected; if the growth is localized the indications are simple, but if the disease is extensive a pan-hysterectomy is performed, as carefully as possible approximating the edges of the broad ligament and inverting the ovarian pedicles. A careful toilette of the peritoneum is made, sacrificing infiltrated portions of the omentum or parietal peritoneum. Drainage is rarely indicated. A tight binder is applied to maintain the abdominal equilibrium.

With recurrence of ascites and the associated symptoms, it may be necessary to remove further portions of the growth by re-operation. In unilateral cases, one ovary and tube should be retained in the childbearing age unless the disease is disseminated or unless the diseased ovary shows gross evidence of malignancy. Sterility is preferable to an incomplete operation when the growth is at all suspicious. If, however, the other ovary is left *in situ* periodical examinations should be made.

Inasmuch as the normal ovarian tissue is particularly sensitive to radiant influence, and moreover, as ovarian papillomata have a relatively low metastasizing power, cases in which the growth has been incompletely excised should be given the benefit of radium.

In every case which has undergone cancerous degeneration X-ray and radium treatment should be given in addition to the operative procedure. An exploratory laparotomy should be done in every advanced case of suspected ovarian carcinoma (unless, of course, the general condition of the patient contra-indicates) to establish the diagnosis, for even though there is much ascitic fluid in the abdomen and palpable nodular masses, no carcinoma may be present, and, moreover, one or both ovaries may still be unruptured.

The X-ray has been given directly upon cancer masses in the omentum and peritoneum through the open abdomen, by holding the abdominal walls open by tapes hooked under the fascia. A seven or eight minute exposure with the tube at 10 centimeters may be given. This method, however, has not met with general approval and has been superseded by the use of radium.

For the use of radium, the cancerous masses are removed as completely as possible but the uterus is left *in situ*. Radium is then placed in the uterus in a platinum capsule. As soon as convalescence is well established, massive doses of radium are placed with a sufficient filter in the vault of the vagina and the rays directed toward the pelvis on either side. In addition the abdomen is radiated through three or more areas with a gram of radium at 4 centimeters distance with a suitable filter. Three areas across the back at the level of the sacrum are also radiated. If the cancerous extensions are above the pelvis the radiation may be given in the form of one pack at 10

centimeters distance for 18,000 millicurie hours, and later the same dose across the back. This gives by summation a very considerable radium dose within the abdomen. The external radiation may be entirely given in the form of X-ray through many skin areas and in a number of series so that the skin may be saved from exfoliation (35).

## CONCLUSIONS

1. Papillary cystadenoma is the most important surgical disease of the ovary.

2 It is variously stated to occur in from 10 to 27.5 per cent of all ovarian tumors.

3. A large number of cases occur in patients under the age of thirty.

4. The most probable development is from a cellular perversion of the germinal epithelium.

5 There is a strong tendency to bilateralism. (22.2 per cent) and local metastasis. General metastasis is not rare.

6. Bilateral ovarian tumors demand a careful examination of the abdominal viscera and breasts.

7. The absence of symptoms referable to the pelvic organs is a deceptive feature of the disease.

8. Ascites is an advanced symptom and indicates rupture, peritoneal metastasis, and often malignancy.

9. Every woman with ascites, without a sufficient explanation in the liver, heart, peritoneum, or kidneys, should be laparotomized even though bimanual examination be negative.

10. Microscopically 66.6 per cent of papillary cystadenomata are cancerous or precancerous.

11. Every ovarian cyst must be removed intact by abdominal section as soon as discovered.

12. In unilateral oophorectomy, the patient should be periodically examined.

13. Careless or rough handling resulting in intra-abdominal rupture, tapping to reduce the size of the tumor and the vaginal approach cannot be too strongly condemned.

14. Radium should be employed in cases in which the ovaries or the peritoneal implants could not be surgically removed.

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# SPLENECTOMY IN THIRD STAGE, BANTI'S DISEASE

## With Report of Case of 15 Months' Standing[1]

By H. B. SWEETSER, M.D., F.A.C.S., Minneapolis, Minnesota

ALTHOUGH much has been written on the subject of splenic anæmia in general and many cases have been submitted to splenectomy with brilliant results, yet, after a fairly diligent search of the literature of the past 20 years, I find that comparatively few cases in the terminal stage, the so-called Banti's stage, have been so treated. Even including cases with the most meager history and with practically no details, I have been able to collect only 42 cases. Therefore, every single case of this type, if treated by removal of the spleen, assumes importance in helping to formulate a proper treatment, and for this reason I present the present report and analysis.

Because of the difficulty, or rather impossibility, of separating true cases of Banti's syndrome, i.e., cases showing enlarged spleen, cirrhosis of the liver with ascites, and an unknown etiology, from other conditions giving similar symptoms, I have included in this analysis *all* cases presenting ascites as a complication of enlarged spleen. Thus are included in the 42 cases analyzed, 7 of primary cirrhosis of the liver with ascites, 3 of syphilis with cirrhosis of the liver and ascites, 1 of thrombosis of the splenic and portal veins, with enlarged spleen and ascites (the diagnosis being made only at autopsy) and 1 of primary lymphosarcoma of the spleen with ascites. Patients presenting themselves with this syndrome are always questionable surgical risks, and it requires considerable moral courage and much surgical enthusiasm to offer so serious a procedure as splenectomy as a method of treatment with so few recorded cases as justification. It has been my purpose, therefore, to try to determine first what has been the immediate mortality, and second what the permanency of results following splenectomy.

Many of the reports are so meager as to be of little value, some of them merely being mentioned casually as having been done with good results, with no reference as to when and where reported in detail, if ever so reported. In others the report has followed the operation so closely that deductions as to permanency of results are impossible, and apparently no subsequent reports have been made, at least I have been able to find such in only a few cases. If we are to arrive at any definite conclusion as to the value of splenectomy in these terminal conditions, it is essential that every case should be reported in detail, with a follow-up report late enough to show ultimate results.

Concerning immediate mortality, prior to 1908 there were 11 cases reported with a mortality of 72.7 per cent; between 1908 and 1913 there were 16 cases reported with a mortality of 56 per cent; and in the 42 cases here reported, with 11 deaths, the mortality was still further reduced to 26.5 per cent. Thus it is seen that a patient has three out of four chances of surviving the operation. In view of the fact that this condition is 100 per cent fatal under medical treatment, this showing is remarkably good. As regards late results: In 5 cases there were no data at all, and these, therefore, are not considered. Of the rest, one was a failure from the start, requiring paracentesis twice a week, but was still alive 8 months after operation; 1 suffered repeated hæmorrhages from the bowel and succumbed at the end of 5 months; 1 was apparently in perfect health at the end of a year, but suddenly died 2 months later from a hæmorrhage from the stomach; 6 were alive and well at last report, from a few months up to fourteen months after operation; and 17 were alive and well for periods varying from 15 months up to 10 years after operation. Thus it is seen that at least 55 per cent of the cases which survived operation lived and remained in good health for more than 15 months; and may therefore be assumed to be permanently cured.

The case of lymphosarcoma was reported in perfect health after 3 years. One other case

[1] Read before the Western [illegible] Association, Los Angeles, December [illegible]

of sarcoma of the spleen was reported in 1908 as having lived for 6 years and a half, then dying of a cardiac affection.

The 3 cases with a definite syphilitic etiology all recovered and 1 was in perfect health at the end of 17 months.

There were 7 cases reported as primary portal cirrhosis of the liver, with 2 operative deaths. One, reported by Sherren, besides ascites, had also marked œdema of the legs and scrotum and fluid in the right pleural cavity, and it is not to be wondered at that death resulted. The other 6 are from the Mayo clinic and are not reported in detail as far as I can find. One died, but the other 5 were reported as "greatly relieved" for periods not recorded. I could find no other cases of cirrhosis so treated. This group surely gives food for speculation as to the future possibilities of splenectomy as a successful treatment of cirrhosis of the liver in its terminal fatal state of ascites. As long ago as 1914, Kidd, commenting on the clinical similarity of Banti's disease with primary cirrhosis of the liver, made the assertion that *all* cases of hepatic cirrhosis with enlarged spleen should be given the benefit of a splenectomy stating that "we now operate on cases labelled Banti's diseases, and it is hard to see where the difference lies." W. J. Mayo, having splenectomized 6 cases, with great benefit in 5 and death in only 1, makes practically the same plea, saying that the results will depend on whether the liver retains sufficient capable cells to carry on its function.

I have found it impossible, on account of insufficient data in both the clinical and pathological histories, to differentiate the cases of undoubted Banti's disease from the others, and have therefore given up the attempt to analyze them separately. My own case, I think, can be classified without question as an undoubted case of third stage Banti's disease, notwithstanding the apparently brief first stage and the lack of clinical verification of an enlarged spleen preceding the cirrhosis and ascites. It is certainly not a primary cirrhosis of the liver, and the possibility of its being syphilitic must be ruled out by the absence of all syphilitic signs, including a negative Wassermann.

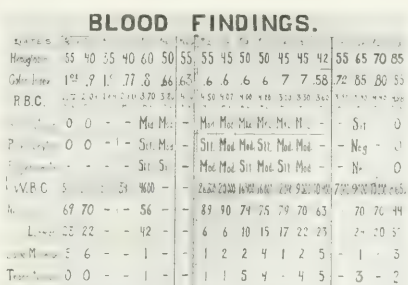


Fig. 1. Blood findings before and after splenectomy.

CASE REPORT

The patient, Mr. A. M., entered St. Mary's Hospital, August 11, 1919, under the care of Lieut. David R. Higbee, Naval medical officer. He is 37 years old, white, of Danish parentage, married 3 years, and has no children. He has been quartermaster in the U.S. Navy for 19 years, and during that time has been in all parts of the world; in the tropics many times.

The family history has no bearing on his disease. His father and mother are living and well at 60 and 65 years of age. Two brothers and one sister are living and well, and two died in infancy.

In childhood patient had measles, mumps, and diphtheria. Tonsillectomy in 1901. In the same year his appendix was removed, followed by 5 operations for the repair of the resultant hernia. In 1904 he suffered from pleurisy, but no aspiration was done. Although in the tropics many times he had never had any of the tropical diseases. Four years ago he had an attack diagnosed as malaria, and has had several similar attacks since. He denies any venereal infection, and has no alcohol habit.

*Present Illness.* Until his present illness patient had always considered himself an exceptionally healthy man. In January, 1919, his wife and friends noticed an increasing pallor and a yellow tinge to the skin, of which he himself was unconscious, and they persuaded him to consult a physician. He was given iron and arsenic, but no examination of the blood was made until May 11, 1919, when his hæmoglobin was found to be 60 per cent. During May he passed many bloody stools, the first very profuse, and on May 23 and 24 vomited about 2 quarts of blood. On June 29 he again vomited blood in less amount, but since then there has been no hæmorrhage either from bowel or stomach. On June 11 the ascites was first noted. During this time he was in a hospital in another city, and a diagnosis was made of either pernicious anæmia or cirrhosis of the liver, and a very gloomy prognosis given. There was no œdema. On July 7, his abdomen was tapped, the

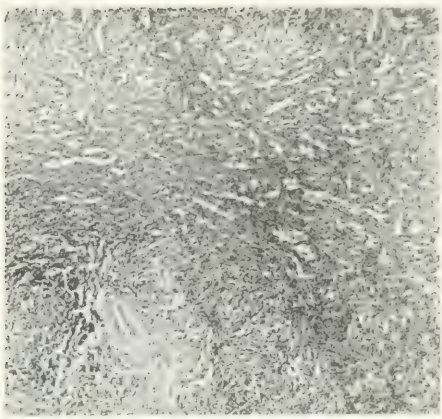

Fig. 2. Photomicrograph of section of spleen, low power note marked fibrosis of splenic pulp.

trocar-fistula remaining open for 12 days, during which time the drainage was very free. Nine days after the fistula closed, i.e., on July 28, he was again tapped. During this time he was given repeated doses of horse serum, elaterium, and cacodylate of sodium. No observation had been made of an enlarged spleen.

On admission to St. Mary's Hospital, Minneapolis, on August 11, 1919, the following record was made: Male, 37, fairly well nourished, active, very alert mentally. Slight tremor. Weight 120 pounds, a loss of 15 pounds in 3 months. Mucous surfaces pale, skin a lemon color, and scleræ quite yellow. Appetite good, no vomiting, bowels regular, no cough, and only slight dyspnœa. The abdomen was very much distended. The spleen, only palpable after tapping, extended to the level of the navel and to the mid-line. The liver was not palpable below the costal arch, in fact its area of dullness was diminished. The temperature varied between 98° and 99½°; the pulse rate between 90 and 120; respiration 20 per minute. There were several formed bowel movements daily, dark-colored, and faintly positive to the benzidine test, but no active hæmorrhage. The urine was clear, acid, specific gravity 1025, faint trace of albumin, no casts, no bile pigments, but on one occasion faintly positive for urobilin. There were no evidences of syphilis, and the Wassermann was negative. August 12, examination of blood showed the following: hæmoglobin 60 per cent; index .8; erythrocytes 3,700,000; leucocytes 6,400; differential, polymorphonuclears 56 per cent; small lymphocytes 42 per cent; mononuclears 1 per cent; transitionals 1 per cent; eosinophils not noted; marked anisocytosis; slight poikilocytosis; no nucleated reds or myelocytes.

On August 21, paracentesis removed 6,000 cubic centimeters of clear straw-colored fluid from the abdominal cavity. On August 26, Dr. Higbee transfused 500 cubic centimeters of citrated blood without benefit, the blood examination 3 days later showing 4,000,000 erythrocytes and hæmoglobin only 54 per cent. On August 31, he was again tapped and again about 6,000 cubic centimeters of fluid were recovered. From the clinical data and blood findings Dr. Higbee had made a diagnosis of splenomegaly in the terminal stage, which was concurred in by his consultants, and had urged operation as giving him his only chance.

On September 1, 1919, I removed the spleen, Drs. D. R. Higbee and Robert Hodapp acting as assistants. Although 6 liters of fluid had been removed the day before, re-accumulation had been so rapid that about the same amount was found at the time of the operation. The spleen was strongly adherent to the parietal peritoneum. A supernumerary spleen, the size of an English walnut, was attached to the tail of the pancreas. In removing this a fair-sized vessel was torn to secure which it was necessary to pass a suture through the pancreatic tissue. The gall-bladder was normal and contained no stones. The liver was small and hard, and its surface hobnailed, some of the elevations being as large as split peas.

The spleen measured 23 by 13 by 6½ centimeters and weighed 850 grams, about four and a half times the normal size. The capsule and trabeculæ were thickened. The malpighian bodies were more or less atrophied and surrounded by a thick layer of fibrous tissue. The pulp was largely replaced by fibrous tissue (Figs. 1 and 2).

*Postoperative history.* Following the operation the temperature for 4 days remained as before, between 98.5° and 99.5°, but then increased to 102° F. and continued between 100° and 102° in the evening, with a daily drop to near normal in the morning. The pulse rate, except immediately after the operation, was only slightly increased, varying between 80 and 120. The ascites recurred rather slowly, but on the twenty-second day after the operation paracentesis had to be resorted to, 6,100 grams being recovered. There was no further ascites, although no attempt had been made to sidetrack the blood stream around the liver by omentopexy.

The change in the blood-picture was prompt and quite striking as regards the leucocytes. On the day following the operation they increased from 4,600 to 27,800, of which 89 per cent were polymorphonuclears and 6 per cent small lymphocytes. This relationship, however, has not been maintained, and at present the total leucocyte count is about 9,000, with only 44 per cent neutrophils and 50 per cent lymphocytes, the large lymphocytes predominating.

The patient left the hospital October 24, feeling well but with a continuous elevation of temperature of about 100° F. Sixteen days later he returned, complaining of a board-like painful swelling in the left anterior abdominal wall, which gradually dis-

appeared without suppuration. His hæmoglobin, however, had receded to 42 per cent, the lowest recorded at any time, and the erythrocytes to 3,600,000. On November 14, 1919, transfusion of 500 cubic centimeters of citrated blood was made. Following this his improvement was steady; temperature and pulse became normal, appetite good, and his weight increased to 139 pounds, several pounds better than his best weight. On January 1, 1920, he returned to active duty and has continued on active duty to the present time.

At my request he presented himself for examination November 13, 1920, i.e. about 3 weeks ago, or nearly 15 months following the splenectomy. He is apparently in perfect health; weight 130 pounds; temperature and pulse normal; heart and lungs normal; no œdema and no ascites. The liver dullness now extends fully to the costal border, showing that there has evidently been considerable regeneration of that organ; jaundice absent. Blood pressure 130–70. He has no dyspnœa, being able to climb the hilly streets of Duluth without discomfort. He has worked steadily without asking favors, lifting, when called on, hundred-pound sacks without effort or distress.

For convenience of comparison the various blood findings, before and after the splenectomy, and at the times of transfusion, have been grouped in the accompanying table (Fig. 1).

The blood picture at present is: hæmoglobin 85 per cent; erythrocytes 4,980,000; color index .85; leucocytes 8,650; differential, polymorphonuclears 44 per cent; lymphocytes 50 per cent; large mononuclears 3 per cent; transitionals 3 per cent; eosinophils 1 per cent.

It is thus seen that a relative lymphocytosis has recurred, and that the normal relationship of neutrophils to lymphocytes is even more markedly disturbed than prior to the splenectomy; in other words, that the blood findings, as concerns the leucocytes, have reverted to the infantile type. What this means, from the standpoint of prognosis, is an interesting speculation. Very little help in solving this question is to be obtained from the cases studied, because in only a few of them have repeated differential counts been made. One of Sherren's cases, after being in perfect health for over a year, suddenly died from hæmorrhage. Unfortunately, in this case, no blood examination was made later than 6 weeks after her operation, but that showed a marked lymphocytosis (53 per cent with a proportional reduction in neutrophils to 42 per cent); the hæmoglobin was 55 per cent. Nullifying this observation, however, are the blood findings in the cases of Kidd, Lissner,

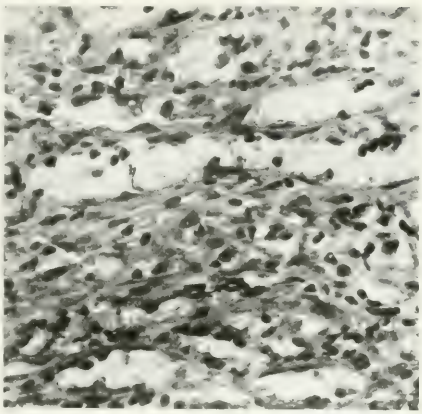

Fig. 3. Photomicrograph of section of spleen, high power. Same section as in Fig. 2. Note great increase in number of reticulum cells.

and Herrick, which were in perfect health 9 and 10 months after operation, when the blood examinations were made, and yet in all of them the relative lymphocytosis was marked. As long ago as 1901, Cabot called attention to the fact that in some splenectomies as much as 5 years were required to re-establish a normal differential leucocyte count. Herrick makes the same observation about the cases of Senator and Wolff.

Nor have I been able to get much light on this from the physiologists or hæmotologists. One theory accounting for the lymphocytosis in these cases seems to me quite reasonable and plausible, as follows: The lymphocytes, especially the small ones, are concerned in tissue building and tissue regeneration, and for this reason we always find a relative lymphocytosis in childhood. Now, under certain conditions, in adult life, as following serious chronic infections recovered from, it is fair to assume that, the tissues having suffered marked degeneration, nature then applies herself to the problem of regeneration, and with this purpose in view, supplies the lymphocytes in increased number as tissue builders. I have come across several facts which seem to substantiate this theory: (1) In Minnesota, one of the coldest states in the country, a neutro-

phile percentage of 50 to 60 and a corresponding lymphocytosis is much more frequently found than the usual higher percentage of neutrophils as given in the textbooks. (2) In Europe, since the second year of the war, apparently everyone has developed a relative lymphocytosis of from 30 to 50 per cent or more. No one has offered any definite explanation of this, but it has been ascribed to nutritional changes.

In my case it is interesting to note, in this connection, that the jaundice and ascites have disappeared and also that the liver dullness now extends to the costal arch, having quite appreciably increased over what was found before operation. I take it that these findings mean that nature has been very busy regenerating tissue, and for this purpose has provided the necessary lymphocytes as tissue builders. If this theory has any foundation in fact, then the presence of lymphocytosis is a good rather than a bad prognostic sign. As long as regeneration continues the lymphocytosis will persist; when the need ceases, then the leucocytes will return to their normal adult ratio.

But more important, apparently, from the standpoint of prognosis, is a theory developed by Professor Downey, hæmotologist in the University of Minnesota and an authority on the blood. He has found invariably in cases of severe toxæmias and of long standing infections that the large lymphocytes predominate and that their cytoplasm contain numerous coarse azure granules. When such findings are present in a given case, he suspects infection and degeneration as still going on somewhere in the body, although his observations are so far too few to allow him to speak with much positiveness on the subject. These findings are present in the slides of my patient's blood, and it will, therefore, be of considerable interest to watch his further progress.

SUMMARY

1. Splenectomy offers the best chance of recovery from the otherwise fatal terminal stage of splenomegaly.

2. A plea is made for detailed histories of all cases of this type, subjected to splenectomy, and also for subsequent reports of progress at sufficiently late date after operation to determine the ultimate result as regards permanency of cure. Only in this way can judgment be formed as to the value of this procedure.

3. In the study of the blood findings, it is not sufficient, from the standpoint of prognosis, to record the differential white count; a more intensive study of the cell structure itself is essential.

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# THE RESULTS OF ALKALINIZATION OF OPERATIVE CASES[1]

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IN considering operative cases retrospectively it is not hard to recall many in which the postoperative course has been stormy and distressing to both patient and surgeon. Symptoms such as vomiting, gaseous distention of the abdomen, scanty, very acid urine with a deep acetone ring, dry mouth and lips and even signs of shock have been encountered. The question arises, what is the cause of these signs and symptoms and how eliminated? To answer this question this paper is attempted.

The outward signs and symptoms closely resemble conditions occurring in acidosis and for that reason investigations were undertaken to determine the underlying causes that lead to the assumption that acidosis occurs in such cases.

## ETIOLOGY

*Pre-operative purgation*, as stated by Emge (1) often leaves the bowel distended by gas and decidedly congested. Alvarez (2) says purgation promotes the danger of alarming flatulence and gas pains. M. M. Peet (3) enumerates as drawbacks, physical and psychic weakness, loss of sleep and intestinal and colonic hypotonicity, and it might be added, dehydration. Sajous (4) believes that there is good ground for the growing opposition to pre-operative purgation when the rôle of the endocrins in the intestinal functions is taken into account. Purgation sweeps from the intestinal canal a product termed "secretin" by Starling, which not only serves to liberate and activate the pancreatic enzymes, but also to promote the production of bile and succus entericus. Sajous' own researches have shown that, besides these functions, the intestinal enzymes contribute to the succus entericus, active bactericidal and antitoxic properties which do much, working in conjunction with the bile, to prevent fermentation changes in the intestinal contents and autointoxication.

*A pre-existing autointoxication* may be present of either intestinal or fæcal origin and only needs mention in passing.

*Starvation*, during and immediately following the operation period, is a well accepted etiological factor in acidosis, and Lincoln (5) urges that surgeons should bear in mind the danger in the preparation of patients for operations, of a too prolonged starvation, especially in children or those suffering from any form of exhaustion.

*General anæsthesia* is nearly always associated with a certain degree of asphyxia, which leads to a suboxidation, which in itself causes an acid intoxication, as pointed out by Crile (6).

*Wide abdominal exposure and intra-abdominal manipulations* predispose greatly to surgical shock, which leads directly to a flooding of the splanchnic vessels and a slowing of the portal circulation. This in turn causes acidosis due to deficient circulation through the liver, also pointed out by Crile (7) who states that neutralization of acids is one of the most important functions of that organ.

## PATHOLOGY

Reimann and Hartman (8) found that after anæsthesia and operation, there was uncompensated acidosis in some patients. In 90 cases studied, the urinary acidity was increased very definitely, until in some instances, almost half normal acid was secreted. Blood urea was also increased.

## TREATMENT

Having considered these facts and noted the end-results of anæsthesia and operation, how shall we endeavor to combat the conditions giving rise to these ill effects?

## PROPHYLAXIS

1. Determine the secretory ability of the kidneys and render the urine as nearly alkaline as possible. This latter may be accom-

[1]Read before the Chicago Gynecological Society, March 18, 1921. (For discussion see p. 438)

plished by building up the alkali reserve of the body; namely, by the administration of bicarbonate of soda to a point of saturation as determined by the reaction of the urine.

2. Increase the fluid content of the body by administration of large quantities of water for 10 or 12 hours preceding operation. (The temporary retention of fluids may be effected by the presence of an excess of bicarbonate, as cited by Max Kahn (9).

(As to pre-operative prophylaxis, in 138 consecutive major operations, Quillian (10) had no mortality and but five cases of shock by resorting to the following routine: sodium bicarbonate, drams ½ in one-half glass water, a half hour before meals. Glucose and bicarbonate, ounces ½ in 8 ounces of water, b.i.d., as a retention enema for 2 days before operation. Liquid diet and large quantities of water for 48 hours preceding.)

3. Avoid drastic catharsis as it washes the intestinal canal free of its normal detoxicating properties; it causes atony of the musculature; dehydrates the patient, causes fatigue and drains the alkali salts from the body.

4. Preclude for a day or two before operation such substances as would tend to intestinal putrefaction and the formation of fatty acids; namely, meats and fats. (This has been emphasized by Sajous and Max Kahn.)

5. Insure an adequate amount of sleep the night preceding the operation and dispel any apprehension as to its ultimate outcome.

(The above is the pre-operative care of the patient and what follows is subsequent to operation.)

As cited by Reimann and Hartman (8) many patients exhibit uncompensated acidosis after operation and to combat this three factors must be considered, namely: (1) the body fluids must be preserved; (2) the alkali reserve must be maintained; and (3) oxidation must be hastened.

The preservation of body fluids may easily be accomplished by the introduction of water into the body by retention enemata, ingestion by mouth, or if need be, hypodermoclysis. The alkali loss may be replaced by the administration of bicarbonate in the retention enema. Wall, of Chile (11), believes that the depletion of the alkali reserve in the blood is the essential element. Starvation acidosis must be counteracted, and he makes a practice of combating post-anæsthetic disturbances by giving alkali by the rectum and even by the vein, and says that the results have been most gratifying in his long experience.

Kahn, in his work on metabolism in diabetic patients has pointed out that when there is a lack of sufficient combustion of carbohydrates there is a disturbance of the fat oxidation of the body, and there are produced the toxic acid bodies, or as he says, "a state of ketosis exists"; therefore, the most obvious procedure is to introduce into the body a carbohydrate that can most easily be burned. This can be accomplished by adding glucose to the retention enema, until a 5 per cent solution is obtained, or sterile solution may even be given by the vein.

To sum up, a retention enema of 8 ounces of a 5 per cent glucose in which has been dissolved 2 drams of bicarbonate of soda, given immediately following the operation and repeated in 6 hours, will fulfill the requirements until the patient is able to take liquids and nourishment by mouth.

Early feeding is advocated, to begin as soon as possible, say the second day, by including milk, carbohydrates and fruit juices. If this is well tolerated, the diet is increased the next, until by the fourth day a general diet is taken.

Soapsuds enemata are ordered when necessary and afford great satisfaction.

The main plea of this paper is to try to bring before you the simple fact that alkalinization of patients before and after operation will aid strikingly to a shortened convalescence and to the mildness of the postoperative disturbances.

So that you may visualize the marked difference in the postoperative conduct of patients previously alkalinized, as contrasted with those *not* previously alkalinized, a table has been prepared, bringing out the five most striking points.

Twenty alkalinized patients are reported with seventeen controls, all operated upon at

TABLE

| Cases | Average No. Days in Hosp. | Average Days of Discomfort | Gas Pains | Catheterized | Emesis |
|---|---|---|---|---|---|
| 17 Non-Alkaline (control) | 15.50 days | 5 days | In 65 per cent of cases—average 3.7 days | 53 per cent of cases, time 3 to 18 days | In 76.5 per cent cases; none in 23.5 per cent; slight 29.5 per cent; moderate 23.5 per cent; severe 17.5 per cent |
| 20 Alkalinized | 13.25 days | 2.8 days | In 30 per cent of cases — average less than 24 hours—1 case 3 days; 2 cases on first day; 2 cases on third day | 25 per cent of cases, plus 1 case with previous cystitis and 1 case with vaginal packing. 1 case catheterized 3 days; 1 case catheterized twice; 3 cases catheterized once | In 50 per cent cases; none in 50 per cent; slight, 30 per cent (emesis only once); moderate 10 per cent; (This case was not alkalinized until after operation) |

about the same time, the operations being similar in both groups; (being hysterectomy, uterine suspensions or the cleaning up of old pelvic inflammations for the most part).

A careful scrutiny of this table cannot help but demonstrate the marked difference in the reaction of the patients treated as compared to that of the controls. To demonstrate more clearly the effect of alkalinization, two condensed case reports are given which were picked because they were surgically difficult cases, were under anæsthesia longer than usual and had continuous ether, all of which predisposes to postoperative complications.

Case 1. M. B. No. 141442. Patient complained of constant, severe pain in lower abdomen which had been present for 10 days; pregnant 4 months. The past history is negative except for pleurisy 2 or 3 years previously. Patient is colored woman, age 26. Examination shows temperature 98.6°, pulse 90; head, neck, throat, chest, teeth, and pupils negative; the abdomen is slightly distended, enlarged, and exquisitely tender, especially over right lower quadrant. Bimanual examination shows the uterus enlarged to the size of a late 4 months' pregnancy. It is covered with numerous tender tumor masses, ranging in size from a walnut to that of a lemon. Last menstrual period was April 29, 1920, due February 5, 1921. Pelvic measurements were 23-27-32-18. Blood pressure 120-85. The urine was turbid, straw colored, specific gravity 1020; reaction, acid; no casts; frequent epithelial, few erythrocytes, few leucocytes. Red blood cells, 3,750,000; white 3,400, hæmoglobin 76 per cent.

Pre-operative diagnosis: fibroids interferring with pregnancy (possible incarceration).

Before taking anæsthetic the pulse was 120, of good quality. The anæsthesia lasted 1 hour, 35 minutes. Ten ounces of ether were used. At end of anæsthesia the pulse was 100, of good quality.

At operation the pregnant uterus was found wedged in the inlet; a much discolored fibroma on a short broad stump was found in the anterior right fundus with another, larger intraumural fibroma seeming to cause the lodging of the uterus in its present condition. On freeing the uterus, other fibromata were seen, one being behind the bladder and one low in the left broad ligament.

*Operation.* A supravaginal, low hysterectomy was done without rupturing the amniotic sac. After anchoring the tubes and ligaments into the stump and completing the "peritoneal toilet" the abdomen was closed in the usual way, 4 retention sutures being used after removing an adherent, chronically inflamed appendix.

*Pathological report.* The specimen consists of the upper 11 centimeters of a pregnant uterus 11 centimeters wide and 10 centimeters thick. Both tubes have been amputated close to the body of the organ. On the right side slightly to the right of the mid-line in front is a fibromyomata 5 by 5.5 centimeters and just outside of this another one 6 by 5 by 4 centimeters that is subserous. Slightly to the left of the mid-line in front is another fibromyomata 4 by 4 centimeters. Anteriorly near the upper pole are two subserous fibromyomata 3 by 3 centimeters and 2.5 centimeters. Behind on the side are two fibromyomata 3 by 2 centimeters and 2 centimeters in diameter. The uterus contains fœtal membranes attached to the placental surface approximately 11 centimeters in diameter. Within the membrane there is a fœtus with its cord 17 centimeters long. No further examination was made.

The patient regained consciousness on return from the operating room. An enema of sodium bicarbonate 2 ounces in 8 ounces of a 5 per cent glucose solution was given at 12 noon and 8 p.m. One-twelfth grain of morphine sulphate was given hypodermatically at 4 p.m. The patient urinated spontaneously 8½ hours after operation. There was no nausea or vomiting. The pulse ranged from 72 to 80. There was no trouble except pain in the abdominal incision. Soft diet was given on the third day. Patient was up in wheel chair on fourth day. She slept well at night. On the fifth day extract of corpus luteum was given for pain in breasts. On the eleventh day the patient had pleurisy in left side, with dry friction rub, and sounds were heard. She was strapped and given 1/6 grain morphine

sulphate hypodermatically twice a day. With rest in bed the patient was better on the fourteenth day and was discharged from the hospital on the twentieth day, there being some delay in leaving the hospital due to the pleurisy, an exacerbation of an old condition.

One month later the patient returned for examination. She was feeling very well, although she had some slight discomfort in the region of the right ovary. On examination it was found that the introitus and urethra were negative. The cervix was well up and back in the hollow of the sacrum. The stump of the uterus was anteroposed and both ovaries were in good condition. Results good.

Case 2. T. A., No. 141873. Patient complained of pain of bearing down nature, in left lower quadrant of back; of profuse watery discharge; that she was easily fatigued; of sterility, and of constipation. She was a white woman, age 26, married 4 years, and had never been pregnant. Appendectomy was performed 4 years ago. She had pain in the left groin 3 years ago. Soon after marriage there was a profuse vaginal discharge. A definite history of pelvic infection aside from the attack of appendicitis was not obtainable. The old pelvic pain, however, flares up each time she catches cold. Menses began at age of 12, have been regular, of the 28-day type, duration 4 to 5 days. She has backache during menstruation.

Pre-operative diagnosis: retroversion, adhesions of the uterus, congestion, prolapse of the right ovary.

The anæsthesia lasted 1 hour 5 minutes, 8 ounces of ether being given. At beginning of anæsthesia pulse was good, 84; at end, good, 96.

*Operation.* Curettage, dilatation of cervix. Median line abdominal incision. The pelvic adhesions were freed and the uterus straightened, a bilateral chronic salpinx was removed, the left chronically inflamed ovary was removed, the right prolapsed cystic ovary drained with cautery and anchored, round ligament operation was performed and raw surfaces covered. The wound was closed as usual.

The patient was returned conscious from the operating room. She urinated spontaneously in 5 hours, slept most of the afternoon. Bromides grains 20 chloral grains 5 caused emesis. Morphine sulphate ⅛ grain was given hypodermatically. The patient had a good night, with pulse 88, temperature 99, respirations 18. On the second day, the temperature was 99.6, pulse 88, respirations 18 in the morning, with evening temperature of 98.6, pulse 64, and respiration 24. She was given liquid diet. No medication, emesis in the afternoon. The patient had a good night; bowel movement. On the third day the temperature was 99.2, pulse 80, and respiration 18. Milk of magnesia was given and vomited as it always has been. Patient had spontaneous bowel movement and was up in chair. Patient had a very good day and night, with evening temperature of 98, pulse of 72, and respiration 20. Aromatic cascara, 2 ounces, was given. On the fourth day the temperature was 98.4, pulse 72, respiration 20. She sat up in chair reading. She was given general diet, no medicine and in all had a very good day. On the fifth day she was up most of the time and had normal bowel movements and no medicine. On the sixth day conditions were the same but she was given enema. Seventh day the same. Eighth day was same except bowel movement (normal) not until afternoon. Afternoon temperature was 100. Tenth day, same. Eleventh day the stitches were removed and the patient discharged.

Final examination of the patient 4 weeks after operation showed no vaginal discharge. The cervix as well as the introitus was negative and the urethra was negative. The uterus was in good position and anteflexed and movable. The right ovary was in good position and not tender to touch. The abdominal scar was firm and clean; no cellulitis was present. Patient has been active about house since return from hospital.

## CONCLUSIONS

The conclusions to be drawn from these observations are:

1. That the giving of alkalies seems unquestionably to lessen postoperative discomfort;

2. That catheterization is required less frequently;

3. That gas pains are reduced to a minimum.

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# EMBOLISM AND THROMBOSIS OF THE SUPERIOR MESENTERIC ARTERY[1]

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WHILE mesenteric infarct can by no means be called—as far as we know—an everyday occurrence, there can be no doubt, however, that owing to the difficulty of the diagnosis and to beliefs in its rarity many cases remain unrecognized. After Watson at the Boston City Hospital became interested in this condition, he found 8 cases in 1 year, although until then only 6 had been recorded in the hospital over a period of 9 years. And if these statements hold true for the acute type of the disease, they hold with far greater verity for the chronic and for that very little appreciated type—where the affection progresses to a spontaneous cure. The instance of the last type presently to be described is only the ninth that could be found in the literature, although a consideration of the etiology and experimental work makes it certain that such cases must occur with greater frequency—that this last type may perhaps be the most frequent of all.

## ETIOLOGY

An intestinal infarct may be due to arterial or venous obstruction, and the frequency of occlusion of each of these channels is about equal. In the arteries the closure is effected by either an embolus or a thrombus. Of the emboli, most find their origin in the left heart, arising either from vegetations on the valves or from thrombi in the auricles. Others spring from atheromatous patches in the aorta. As illustrating the rarer sites of origin may be mentioned Virchow's case where the embolus originated from a thrombus in the pulmonary vein, and Klob's case where a thrombus in a patent ductus Botalli furnished the source. Occasionally no site of origin can be found.

On the other hand thrombosis of the superior mesenteric artery or its branches is most frequently associated with arteriosclerosis. Very rarely the sclerosis is primary in the mesenteric arteries. Usually it exists with similar changes in other parts of the vascular system. Other causes for arterial thrombosis are pressure of an aortic aneurism on the origin of the mesenteric artery and also extension of a clot from an aortic aneurism into the mouth of the artery.

On the venous side nearly all of the mesenteric infarctions are due to thrombosis. While at times no cause for the thrombus can be found, and again the associated lesion—such as parotitis—seems quite remote, there are two common conditions with which it seems peculiarly associated. The first of these is acute appendicitis. Here the extension of infection up the veins often terminates in suppurative pylephlebitis. The second condition is an acute inflammatory lesion of the female pelvic organs. Thrombosis has further been described as occurring with a host of diverse and apparently unrelated conditions, among which are abscess of the mesenteric glands, breaking down carcinoma of the pancreas, phlebitis of the lower extremities, prostatic abscess, suppurative parotitis, cellulitis of the neck, and uræmic ulcers of the intestine. Further it may be mentioned that the mechanical factors acting in volvulus, strangulated hernia, and intussusception sometimes give rise to thrombosis of the affected veins. And finally there is a group of cases where the thrombus extends into the superior mesenteric vein from the splenic or portal veins.

It may be noted in passing that whereas closure of the artery may be suddenly effected by an embolus, or gradually by a thrombus, venous closure is gradual in that it is usually due to thrombosis. It is possible that occlusion by a thrombus may be gradual to a certain point, and that a rapidly forming clot may quickly complete the closure. Woloschin, too, has described a case where liver cells were found in the intestinal wall and he believed they were carried as retrograde emboli down the mesenteric vein. There-

[1] From the Service of Dr. A. A. Berg.

fore it seems likely that other retrograde emboli exceptionally may find lodgment in the vein, and some cases where such an origin seemed probable have been described (Reich).

EXPERIMENTAL

A glance at the numerous anastomotic channels of the superior mesenteric artery and its branches would suggest the conclusion that if sudden closure of this vessel occurred, the collateral channels could effectively transmit blood to the anæmic parts. Nevertheless, in 1847, Virchow described a case in which closure of the superior mesenteric artery resulted in an intestinal infarct, and 7 years later he described a second one. But the undoubted presence of the anastomoses was so striking to Cohnheim, that he sought for a further explanation of these infarcts and felt that they occurred only where in addition to a closure of the main branch there was a further occlusion of the smaller branches by propagation of the thrombus or by particles breaking off from it and being carried further down to act as emboli. While these conditions did occur in some cases, e.g., in Virchow's first case, where the thrombus had grown down into the smaller vessels to within one-half inch of the intestinal wall, in reality they were absent in most of the cases. And so Faber attempted to explain the inconsistency by declaring that although the collateral circulation did exist, in view of the length of the intestine, it was far easier for the blood to pass through the natural channels than through the new ones. And, then, to answer the questions involved, there grew up an abundant mass of experimental work which has divided itself along two lines: first, the desire to determine whether the superior mesenteric artery or its branches acted like terminal arteries in spite of their anastomoses and if so why; and second, the creation of non-fatal intestinal lesions by disturbances of the circulation to study the processes of repair and to see if stricture formation is in any way a possible outcome

We may divide the experiments into the following groups:

1. Ligitation of the superior mesenteric artery or its branches. This experiment simulates what naturally occurs at the sudden lodgment of an embolus. However, not every embolus immediately causes a complete occlusion, for though it may be arrested it may not exactly fit the contour of the vascular lumen.

2. Ligation of the superior mesenteric vein and its branches. There is no analogous occurrence in life except the rare event of a retrograde embolus. Closure of the mesenteric vein is usually effected by a thrombus which blocks gradually, and not suddenly, as the ligature does.

3. Artificial emboli. A foreign substance such as oil has been injected into the superior mesenteric artery. The resultant condition is not exactly parallel to the embolic processes in man, for a much larger quantity of the foreign material is used and it spreads itself into numerous branches. Oil, too, is a fluid substance and can, therefore, flow into much smaller vessels than the brittle cardiac embolus which cannot change its form.

4. Severing of the mesentery for varying lengths from its attachment to the intestinal wall. This procedure is used to produce non-fatal intestinal lesions and to study the resultant repair. Its effect is, perhaps, somewhat analogous to what occurs in man when an embolus becomes lodged in one of the smaller branches and then grows downward into all the terminal branches as far as the mesenteric attachment.

Before considering these experiments in detail, it may be profitable to consider very briefly the anastomotic channels. Through the anastomosis of the superior and inferior pancreaticoduodenal arteries, a channel between the hepatic artery and the superior mesenteric artery is created. The anastomosis of the middle colic and the left colic creates a similar channel between the superior and inferior mesenteric arteries. It may also be mentioned that in Chiene's case the last dorsal artery on the right side anastomosed with a branch of the ileocolic. Further the individual branches of the superior mesenteric artery anastomose freely among themselves. In a rough way each branch may be said to subdivide into two others and each of these smaller branches forms an arch or

series of arches with the contiguous branch of the neighboring artery; from these arches the blood supply of the corresponding area of intestine is derived. Or looked at in another way, these arches may be said to form a sort of irregular but continuous vessel or series of vessels running parallel to the intestine, supplied at intervals by branches from the superior mesenteric artery and in turn giving off branches to the intestine.

We may now consider the first group of experiments. They seek to ascertain whether the collateral circulation of the small intestine is competent to prevent infarction after ligation of the trunk of the superior mesenteric artery.

If this experiment is performed on a dog, there follow violent tetanic contractions of the small intestine. These contractions are especially noteworthy and their importance will be dwelt upon later. With marked anæmia of the intestine they persist for 2 to 3 hours and are succeeded by a state of relaxation which is accompanied by marked congestion. Finally, a hæmorrhagic infarct supervenes. From the time of Litten and Faber in 1875, to the experiments of Niederstein in 1909, practically all observers are agreed that ligation of the main trunk of the superior mesenteric artery leads to such an intestinal infarction. There can, therefore, be no question that this is the almost invariable—if not the constant—result. Yet a few voices are raised in dissent. Far back in 1858, Beckman, who worked with rabbits, could see no infarction 6 hours after tying the superior mesenteric artery, but he gave no details of his experiments. More recently Ravenna records that among his numerous experiments on dogs, cats, and rabbits, ligation of the superior mesenteric artery was occasionally without effect. And so, while we must accept the conclusion that, in spite of the collateral circulation, a sudden closure of the main trunk of the superior mesenteric artery is followed by intestinal infarction, yet we may remember that animal observations exist—few though they be—where this result did not follow.

The mechanism by which the collateral channels answer the sudden demand to supply blood to an ischæmic area has been partly determined. Blood travels from one part of the circulatory system to another because of difference in pressure. It will naturally flow from the point of greater to the point of lesser pressure, and it seems logical to attribute the readjustment to the establishment of new pressure relations. Welch and others have shown that when an artery is ligated the anastomosing vessels may, under proper conditions, be seen to dilate and that at the same time the velocity of the blood flow in them is increased. This phenomenon may be brought about either by an increase of the central pressure or by a diminution of the peripheral resistance, and of the two, it is the latter that is the most important. Von Recklinghausen called attention to the fact that the blood from the anastomosing artery could flow not only into its accustomed channels but also into the anæmic area, thus giving it a larger peripheral field and hence a diminished peripheral resistance. To this factor is probably added a dilatation of the ischæmic stream bed itself, which also diminishes peripheral resistance. The importance of that marked initial spasm of the intestinal musculature following ligation of the main artery thus becomes apparent. Certainly with the intestinal wall in this contracted state the normal method of re-establishing the collateral flow by a dilatation of the affected vessels becomes impossible. Not alone is the peripheral resistance not lowered, but it is actually increased. It is, therefore, obvious that in spite of the collateral channels this phenomenon will very markedly hinder a re-establishment of the compensatory vascular flow.

The next group of experiments is concerned with ligation of branches of the superior mesenteric artery. Ligation of a single small branch is uniformly without effect. If the ligature is applied distal to the anastomosing arches, that is, if one of the vasa recti are ligated, the neighboring vessels make up the supply through the rich anastomoses in the submucosa. If, however, ligation is performed proximal to these arches then the anastomoses of the arches insure an easy readjustment. Ravenna, however,

states that sometimes ligation of one of the primary branches of the superior mesenteric artery is followed by infarction. Most men have found though that even this procedure is without effect.

Ligation of the superior mesenteric vein leads constantly to a hæmorrhagic infarct. No contrary results are recorded. It should again be emphasized that such a sudden closure must be very rare in man and limited to those cases in which a retrograde embolus is responsible. Closure is usually effected by thrombosis. Ligation of single or even multiple branches of the vein is without effect (Niederstein).

Injection of paraffin into the main trunk of the superior mesenteric artery constantly produces infarction. Injection into the smaller branches according to Niederstein has the same effect. This investigator noted, too, that when a large area of gut was involved the central portion of the infarction was anæmic while the outer portions were hæmorrhagic. Simultaneous ligation of the corresponding vein served to increase the hæmorrhagic nature of the infarction.

These findings are further elucidated by the next group of experiments, in which the mesentery of the intestine is severed for varying lengths from its intestinal attachment. Niederstein found in dogs that such severance for a distance of 3 centimeters caused a superficial necrosis of the mucosa and for 5 centimeters a necrosis of the mucosa as well as hæmorrhages into the other coats, or else a circumscribed ulcer of the mucous membrane. None of the animals died unless more than 5 centimeters were cut away, in which case a hæmorrhagic infarct developed and death resulted. Other observers agree with these findings. Schloffer working with rabbits found 3 centimeters the margin of safety. These experiments test the adequacy of the collateral circulation that exists in the submucosa of the intestine, in contradistinction to most of the previous experiments which tested the adequacy of the collateral channels outside of the intestine. They shed light, too, on the paraffin injection experiments. This substance because of its fluidity extended down into the vessels passing into the intestinal wall. Naturally when the contiguous arteries over an area greater than 5 centimeters—the margin of safety—were blocked we would expect an infarct.

It is further interesting to note in the last group of experiments, that many of the animals with the non-fatal lesions which were killed in from 24 to 48 hours showed necrosis of the mucosa and hæmorrhages in the muscularis (Niederstein). In fact the impression is created that if a sufficient number of animals is used, and varying lengths of mesentery severed, lesions ranging from small mucous ulcerations to large areas with necrosis of all the walls may be produced. The important fact is that *not all lesions are fatal and many heal completely* (Schloffer).

It may also be emphasized that the lesion that first manifested itself was in the mucosa and that it then extended outward to the other layers. This is more or less true of the experimental findings in all the types of experiments. Whenever an injury was sufficient to cause only a mild change, that change was almost always limited to the mucosa. This coat seems to be the one that suffers first and when all the coats are involved it usually suffers most. Inasmuch as destruction of the mucosa is usually accompanied by some bleeding that may become manifest in the stools, it is possible that, even in the less severe injuries in man, blood in the stools may give a clue to the condition

### DEDUCTIONS

Having considered the effects of the circulatory disturbances of the mesenteric vessels in animals, we may with a fair degree of certainty predict the effects of similar disturbances in man. In animals sudden closure of the superior mesenteric artery leads to intestinal infarction. In man the same result may be expected to follow sudden closure due to the lodgment of an embolus, and that is what actually does occur. Reich collected 68 such cases from the literature. These findings are perfectly consistent then with the expectations created by the experiments. It will be remembered, however, that mention was made of two workers, Beckman and Ravenna, who reported that ligation

of the superior mesenteric artery was at times without effect. Their findings at least suggest the consideration of a further possibility in man, namely, that sometimes the lodgment of an embolus does not produce infarction. If such an event did actually occur, it might, of course, easily escape detection; certainly during life, when the diagnosis would be most difficult, and also at the autopsy table, where a normal intestine would not direct attention to the mesenteric vessels.

Concerning a more gradual closure of the superior mesenteric artery as occurs with thrombosis, the animal experiments tell us less. Nevertheless our knowledge of some of the factors of the circulation will lead us to expect certain results. We know, for instance, that while an embolus of the femoral or the iliac arteries often leads to gangrene, a slow closure by a thrombus may have no such effect. And Nunez's case shows that exceptionally even a thrombosis of the abdominal aorta is not followed by gangrene of the extremities. We may, therefore, reasonably assume that inasmuch as known collateral circulatory channels exist, a slow forming thrombus of the superior mesenteric artery and its consequent closure may at times be without effect.

The findings in man agree with this assumption. Here again the number of cases is meager, for if systematic examination of the superior mesenteric artery is not performed in all autopsies the lumen will not be examined unless some condition present draws attention to this artery. Thus Nazari found 7 cases of arteriosclerotic closure of this artery in 1,700 autopsies. In only one case had an intestinal infarction resulted. And Schley makes the statement that in 1,600 autopsies at the Johns Hopkins Hospital 4 cases of mesenteric thrombosis were found which had given few or no symptoms during life and which were not diagnosed. Excluding their findings, there could be found in the literature only 4 isolated cases where closure due to a probable thrombus had permanently resulted in little or no change to the intestine. In each of these cases there was some condition present that may have directed attention to the superior mesenteric artery. In the cases of McCallum and Trotter, an aneurism of the aorta was found pressing on or involving the superior mesenteric artery. Chiene's case was discovered in the dissecting room because the injection of the blood vessels showed an enormous development of the compensatory circulation, and Howse's case had many ulcers of the small and large gut and a thrombus that extended into the aorta.

On the other hand Reich collected 28 cases in which thrombosis led to intestinal infarction. How often a thrombus of the superior mesenteric artery leads to an infarct and how often it is without effect, we have no way of judging. Certain it is that many people die with obliterated anterior tibial arteries that have never been discovered because the closure has never resulted in gangrene. But when gangrene does occur attention is quickly directed to the artery. The same is true of mesenteric thrombosis. Our attention is vividly drawn only to the cases where infarction has occurred. The statistics of Nazari mentioned above are slightly suggestive. Six times arteriosclerotic closure was without effect, and only once had it produced an infarct. There cannot be the slightest doubt that did we look for these cases we would find more of them. They establish definitely that a gradual closure of the superior mesenteric artery by a thrombus may be followed by no pathological lesion of the intestine, because the mechanism for the establishment of the collateral circulation has had time to adjust itself.

But how are we to interpret such a case as the one described by Karcher?

A woman aged 41 was admitted to the hospital with symptoms of pronounced cardiac failure. Soon after she went into profound collapse, and complained of violent abdominal pains in the region of the umbilicus. Numerous bloody stools followed. Examination showed marked abdominal distention and generalized tenderness. At the same time she also complained of severe pain in the left lower extremity. The abdominal symptoms gradually subsided, but gangrene supervened in the left leg and 6 weeks later necessitated amputation. Her heart failure, however, grew worse and she died a week after the operation, this being 7 weeks after the onset of the acute abdominal symptoms. At autopsy in addition to disease of the mitral, tricuspid, and

aortic orifices, there were found lateral thrombi in both auricles and a ball thrombus in the left. Infarcts of the lungs, spleen, and kidneys were present and an obliterating thrombus of the left profunda femoris. What is most interesting, however, was that the superior mesenteric artery was completely blocked by a thrombus which extended from near the origin of this vessel downward for a distance of 37 millimeters and also laterally into the superior pancreaticoduodenal artery. The thrombus was firmly adherent to the arterial wall. In spite of this closure there was only slight reddening of the mucous membrane of the ileum.

A thrombus may be primary and due to some local exciting cause, or it may be secondary and due to an embolus. When an embolus is arrested in a vessel, if the individual does not succumb, it finally becomes adherent to the arterial wall and is gradually organized. Under such conditions the clinical history and associated findings at autopsy will help us to establish whether the resultant thrombus is primary or secondary to an embolus. Microscopic examinations have been reported in only a few cases. If the individual has a history of valvular heart disease, accompanied perhaps by obvious embolic phenomena, and if at autopsy an origin for emboli exists, such as a cardiac thrombus, and further if old and recent infarcts are present in other organs, such as the kidney and spleen, we may be quite certain that under such conditions a thrombus in the superior mesenteric artery originated from an embolus thrown off from the same cardiac thrombus that caused the emboli in the other organs. If, on the other hand, marked arteriosclerosis exists, and if this is evident in many of the branches of the superior mesenteric artery, it will be very likely that the thrombus originated at the site where it was found.

Considering the above case in the light of these observations, it will appear evident that the closure of the superior mesenteric artery was affected by an embolus which later became organized. The acute abdominal symptoms were caused by its lodgment, and this embolus was discharged almost simultaneously with an embolus to the left lower extremity. Some injury undoubtedly was done to the intestine, for bloody stools, marked pain, and distention were present. But 7 weeks later the embolus had become organized and there was only slight reddening of the mucosa of the ileum. We have here a case where a sudden blockage of the superior mesenteric artery was not followed by a fatal result, where the collateral circulation re-established itself at once in spite of the fact that the patient was suffering from myocardial insufficiency.

Kolbing describes a similar case. His patient also suffered from chronic valvular disease accompanied by many embolic phenomena, and the superior mesenteric artery was blocked by an embolus. Here, too, there was only slight reddening of the intestinal mucosa. Kolbing does not definitely state whether the embolus was in a branch or in the main trunk. The impression created, however, is that it was in the trunk of the artery. Virchow (46 and 48) also describes two similar cases. And so just as some observers did report that no effect followed the sudden experimental closure of the superior mesentric artery, although that was the most exceptional result, we find that in man a similar outcome is possible.

Granted now that a collateral circulation has been established after an embolus or thrombus has occluded the artery, will this collateral circulation remain permanently effective? Pommer has described the following case. A thrombus was found in the superior mesenteric artery reaching down into the colica media and dextra. It was firmly adherent to the arterial wall and organized in parts. There was an infarct of the entire small intestine and cæcum.

The organization of this thrombus indicates that it must have been present for some time, that it was a question of weeks or months and not days. A collateral circulation sufficient to nourish the intestine must, therefore, at one time have existed. Nevertheless death was caused by a recent intestinal infarct.

It will be remembered that the establishment of a collateral circulation is dependent on new relations of pressure. There is a diminution of peripheral resistance caused by dilation of the anastomosing arteries and the stream bed, with maintenance or slight increase of the central pressure. A large

number of people in whom these infarcts occur are patients suffering from valvular disease and hence liable to decompensation. This means that the effective driving force of the heart is lessened and that a condition of venous stasis is present which prevents the arteries and capillaries from readily passing on their contents. In other words, there is a diminished central drive and an increased peripheral resistance—quite the opposite of what is necessary. The result is naturally that the rate of flow is slowed and that a smaller volume of blood than normal will pass through an artery in a given time. Also the quantity will grow less as the decompensation grows greater. Now the collateral channels that supply blood to the intestine after closure of the superior mesenteric artery must primarily nourish their own fields. It is true that these channels dilate. Nevertheless, if they must carry in addition to their normal quantity of blood a supply necessary to nourish the entire small intestine and over half of the large, a rapid flow would appear to be indispensable. However, with the advent of severe cardiac decompensation the rate and volume of this flow is distinctly lowered. It naturally follows then that part or the whole of the small intestine will receive an insufficient blood supply, and the extent of the area so deprived will depend on the severity of the decompensation and the adequacy of the collateral channels. It is, therefore, wholly possible to find cases with recent mesenteric infarction in spite of old standing closure of the superior mesenteric artery. This has happened also in the cases of Virchow (47), Cohn, Schnitzler, and Lepine. In the cases described by the last two, the breakdown occurred after an old primary thrombosis. In Virchow's patient an embolus that had become organized was the original offending agent. This is very interesting for it shows that with the primary lodgment of the embolus the collateral circulation had immediately been established but that with the failure of the heart it had broken down. The same thing occurred in Cohn's patient.

From what has already been stated it must appear perfectly evident that closure of the superior mesenteric artery is not followed by constant results. Yet it must be equally clear that these varied results are not merely chance happenings. They are dependent on perfectly constant factors, some known and others unknown.

There are still some very interesting variations to consider. Thus Rittershaus describes the following case:

A man, age 46, was admitted to the hospital with symptoms of marked myocardial insufficiency. He subsequently developed pain in his left lower abdominal quadrant and died soon after. At autopsy there was found marked sclerosis of the aorta with calcified plaques that were covered with thrombi, and an embolus 1 centimeter long in the origin of the inferior mesenteric artery, projecting into the aorta. The embolus was not adherent to the arterial wall and it blocked only about three-quarters of the arterial lumen. Nevertheless there was an infarct of the descending colon and sigmoid.

Nothing has been said above about closure of the inferior mesenteric artery, but experimentally that vessel acts much like the branches of the superior mesenteric. Its sudden closure may be followed by an infarct, but usually there is no effect. It is then quite remarkable that only a partial closure should result in an infarct. There is no parallel observation of a like occurrence in the trunk of the superior mesenteric artery, but Deckart describes a similar condition in the ileocolic artery, a branch of the superior mesenteric.

A woman, age 47, who had previously been treated for uræmia, was admitted to the hospital with another impending attack. A few days later violent colic-like pains developed in the abdomen, then bloody stools followed and the patient soon died. At the autopsy table two-thirds of the lumen of the ileocolic artery was found blocked by a firmly adherent thrombus. Arteriosclerosis of the other mesenteric vessels was also present. In the last part of the ileum was an ulcer.

It should be stated that limited necrosis producing single or multiple ulcers occasionally results from a closure of the superior mesenteric artery or its branches. This is also illustrated in the cases described by Ponfick and Parenski.

To explain the above cases of Rittershaus and Deckart we may refer to some experiments of Welch and Mall. They ligated all of the collateral anastomosing branches (no

names are mentioned, but they were probably the inferior pancreaticoduodenal and the branch of the colica media anastomosing with the colica sinistra) of the small intestine, and tied off the upper and lower end of the intestinal lumen. Nothing happened. They then gradually constricted the "main artery" (superior mesenteric). When the pressure as measured in one of the branches reached one-fifth of the normal, hæmorrhagic infarction resulted in spite of the fact that blood continued to flow through the artery—and they made sure of this point. This experiment is almost duplicated by the two cases mentioned above. The cardiac decompensation produced a slowing of the flow, the incompletely obliterating thrombus or embolus produced a partial occlusion, and the collateral channels were rendered incompetent both because of the cardiac decompensation with its resultant diminution of vascular flow, and because of their inability to dilate owing to atherosclerosis. It seems probable that the pressure beyond the thrombus was lower than the minimal of one-fifth normal—which Welch and Mall say is necessary for the life of the part—and hence an infarct resulted.

One further effect is possible and this is illustrated by the case of Councilman.

A woman, age 85, developed symptoms of intestinal obstruction that grew progressively worse and caused death. There was vomiting that became distinctly fæcal, and obstipation that resisted all treatment. At autopsy the abdominal aorta was covered with calcified plaques, many of them surmounted with thrombi. A thrombus over the mouth of the superior mesenteric artery extended for a short distance into it, but did not completely occlude the lumen. There was no change whatever in the intestine.

Here we have an incompletely obliterating thrombus causing death, not by an infarct, but by the production of intestinal obstruction. That can only mean that the intestine was supplied with sufficient blood to maintain life, but not enough to maintain function and permit peristalsis. There seems to be a separate threshold for life and for function, and though they are undoubtedly very close, they are apparently distinct. This is a phenomenon more commonly appreciated in the condition known as intermittent claudication and will be dwelt upon more fully later.

The case described by Reich may be interpreted in the same way:

The patient presented typical symptoms of intestinal obstruction and was, therefore, explored the day after the onset. At the operation no cause for the condition was found in spite of a thoroughly orderly search of the gut from one end to the other, and so the wound was closed. Obstruction, however, persisted in spite of a later colostomy and ileostomy and the patient died. At autopsy in addition to arteriosclerosis of the aorta with thrombus formation, the superior mesenteric artery in its course under the pancreas was filled with a non-adherent gray thrombus mass extending also into the two first branches. The jejunum for a distance of 70 to 80 centimeters was the seat of a hæmorrhagic infarct. It is evident that at the time of the operation sufficient blood was coming through the collateral channels to maintain life but not function, for intestinal obstruction was present although no pathological lesion was found in the intestine. But this collateral circulation broke down, perhaps as Reich suggests, owing to the extension of the thrombus into the inferior pancreaticoduodenal artery (one of the anastomotic channels), and then a hæmorrhagic infarct resulted.

These cases suggest very strongly a possible cause for unexplained obstruction at operation and on the autopsy table.

Summarizing then, we find that a closure of the superior mesenteric artery, whether sudden or gradual in nature, may be followed by three possible results:

1. Complete establishment of a competent collateral circulation which will (*a*) persist effectively throughout the patient's life; or (*b*) subsequently break down, usually because of aggravated disease of the heart or the blood vessels.

2. Intestinal obstruction without infarction owing to a blood supply sufficient for life of the parts but not for function.

3. Intestinal infarction, with the injury varying through all stages from a moderate lesion of the mucosa to pronounced necrosis of all the intestinal walls.

Having considered closure of the main trunk of the superior mesenteric artery at length, closure of its branches may be more rapidly disposed of, for the same principles govern here. It will be remembered that in the animals ligation of the smaller arteries was uniformly without effect, and that liga-

tion of the larger branches was usually followed by the same result. In man with an adequate circulation and with competent blood vessels we should expect similar findings. At autopsy the thrombus or embolus will be found only if sought for, as the healthy condition of the intestine offers no clue to its presence.

Elliot gives interesting evidence bearing out the above conclusions. He ligated an artery and vein supplying the ileum "within several inches" of the root of the mesentery. These had been ruptured by a trauma. Nothing happened to the intestine.

On the other hand where some degree of cardiac failure exists or where diseased blood vessels that cannot dilate are present we should expect, if some of the larger branches are suddenly blocked, similar effects to those that follow sudden obstruction in the main trunk. In fact the classification mentioned above for the main stem will hold for the branches, except that the first group, which embraces the cases where there is no effect, will surely be the most common. As examples of the third group, in which infarction occurs, may be mentioned Deckart's case already referred to above, where with only partial closure of the ileocolic artery an infarct resulted, as well as a second case of his in which an embolus in one of the main "branches" caused 2 centimeters of gangrenous gut. Koster describes a similar case.

Closure of the superior mesenteric vein and of the portal vein is an exceedingly interesting but very extensive subject. Only the main points will be considered. It was stated above that ligation of the superior mesenteric vein in animals caused infarction. It was noted, however, that closure in man probably occurred by the slower process of thrombosis, and that, in view of the good collateral circulation, such a result would have little effect. Nevertheless at times infarction does occur. But Reich, who has carefully analyzed all the cases, concludes that it is produced only when the thrombus has grown down in the branches until it has reached the intestinal wall. His evidence and conclusions seem sound. It will be remembered that only from 3 to 5 centimeters of the intestinal wall could be separated from its mesenteric attachment without causing infarction, and closure of the terminal veins over a similar area evidently has the same effect.

### SYMPTOMS

In considering the symptoms of the different groups mentioned above, it will be most profitable to take up the third group first, that is, the cases in which closure of the artery leads to infarction. The symptoms will be most readily conveyed by the description of a type case. It is perhaps needless to add that infarction due to venous closure presents the same symptoms.

A person of middle age, perhaps with evidence of chronic valvular disease or arteriosclerosis and possibly a history of previous embolic phenomena, is suddenly seized with violent abdominal pains and goes into collapse. He rallies from the shock and for a time the pain may subside, but it recurs with gradually shortening intervals, is colic-like in nature and very intense. At the same time or later diarrhœa may manifest itself, the stools at first being very copious and watery, then later containing large quantities of bright red blood. The diarrhœa may be only a minor symptom or absent. Symptoms of intestinal obstruction occur next, including unyielding obstipation and vomiting which may be bloody or fæcal. The picture then merges into that of general peritonitis and finally death supervenes.

Examination of the abdomen at the onset will show tenderness, either diffuse or localized to one of the quadrants. Gradually distention becomes more and more marked and finally the rigidity and the tenderness of peritonitis may be elicited.

To summarize then, we have an individual in whom there exist etiological factors for closure of the mesenteric vessels, such as cardiac disease, arteriosclerosis, or a recent operation, who suddenly develops violent abdominal pains, often accompanied by bloody stools, the whole picture merging into that of acute intestinal obstruction and finally peritonitis.

Reich summarizes the individual symptoms as follows:

*1. Occurrence.* Most of the cases occur between the ages of 20 and 60. Men were affected in 64 per cent, women in 36 per cent of the cases.

*2. History.* In one-third of the cases there was a negative past history. Among the remainder symptoms of valvular disease, arteriosclerosis, aneurism, etc. had previously been noted.

*3. Exciting causes.* Among these are operations such as gastro-enterostomy, herniotomy, and appendicitis, the latter being sometimes followed by arterial as well as septic venous thrombosis. Exertion, such as straining at stool, lifting heavy weights, and coughing have also been noted as exciting causes. Pregnancy and parturition are among the frequent precursors of septic venous thrombosis.

*4. Individual symptoms. a. Pain.* This is very severe, usually colic-like in nature and is the most constant symptom. It was present in 85 per cent of the cases. It may occur at intervals but these rapidly grow shorter. This pain merges into that of peritonitis. In one-half of the cases it is generalized; in the other half it may be localized to any area of the abdomen.

*b. Obstipation.* This is usually present at some time during the course of the affection but occasionally may be absent.

*c. Vomiting.* At the onset this is reflex in origin. Later it is due to the obstruction and finally may become fæcal. In 16 per cent of the cases it is bloody and then especially significant.

*d. Stools.* Bloody stools are an almost pathognomonic sign when associated with the other symptoms. Unfortunately they occur in but 30 per cent of the cases (41 per cent in the Jackson, Porter, and Quinby series). Diarrhœa, with thin, watery, copious stools is not uncommon, and often precedes the obstipation. Sometimes it is absent throughout, and sometimes it may interrupt an attack of obstipation.

*e. Abdominal symptoms.* These will naturally vary according to the time of the examination. Tenderness is present in the large majority of cases (although Jackson, Porter, and Quinby found it absent in 30 per cent of their series) and is usually generalized. In one-third of the cases, however, it may be localized to one area such as the right lower quadrant. Distention although it may be present at the outset is usually a late sign. It was found at some time in 78 per cent of the Jackson, Porter, and Quinby series. An abdominal exudate has also been made out, but in some of these cases a previous ascites had existed due to nephritis or valvular disease. A rarer but much discussed sign is the presence of a fixed coil, that is, the ability to palpate the thickened infarcted coil through the abdominal wall. Naturally obesity or free fluid will hinder adequate palpation. This sign has been described in only 7 cases, although it seems probable that careful palpation would more often show its presence, and it is possible that, as Reich suggests, the symptom of local distention described in 20 per cent of the cases may at times have been the infarcted coil. Cohn, in one of the early cases, described a large hæmatoma between the leaves of the mesentery.

*f. Temperature.* The early writers believed that the temperature was always subnormal. It may, however, be either normal or subnormal at the beginning. With the onset of peritonitis it rises.

*g. Duration.* Sixty per cent of the fatal cases (including those caused both by embolism and thrombosis) die within the first week. In the remaining 40 per cent the illness lasts 2 and 3 weeks and often longer. There is evidently a valiant but futile attempt to establish a collateral circulation. The occurrence of these latter so-called "chronic" cases will not seem surprising. Following occlusion of the superior mesenteric artery, there are, at one end, the individuals in whom a permanent collateral circulation is immediately established; at the other end, the individuals in whom infarction just as readily results. Between these extremes are the cases in which there is a more or less difficult and perhaps prolonged struggle to effect compensation. If this struggle proves successful we may never know the etiology of the symptoms; if not, infarction discovered either on the operating or autopsy table readily clears up

the picture. From what has been stated above, it will further be recalled that not all the symptoms are due to the pathological lesion in the intestine but that many are incident to the vascular occlusion.

Reich also suggests the following groups for the different types of cases:

*a. Diarrhœal group.* The diarrhœal movements begin at the outset and persist throughout the course of the illness, or cease with the onset of peritonitis. The movements occur very often and are very profuse. At times the stools are bloody. This group comprises about 15 per cent of the cases.

*b. Obstructive group.* Obstipation persists from the onset of the pain to death. Occasionally diarrhœa precedes it. Bloody vomitus occurring with this form is especially significant. This group comprises about 35 per cent of the cases.

*c. Mixed group.* Here the above two groups are intermingled. Most commonly diarrhœa at first is later followed by obstipation. Less frequently the order is reversed and cases also occur where diarrhœa and constipation alternate. Occasionally before death bloody stools may interrupt an attack of obstinate obstipation, and in some cases too a normal movement may interrupt such an attack. This group includes 34 per cent of the cases.

*d. Group with meager symptoms.* Here the diagnosis is practically impossible. This group occurs especially among cases of coma, uræmia, apoplexy, senile dementia, but is not limited to such individuals. They may show rapid collapse with abdominal distention and indefinite abdominal pains. This group comprises 16 per cent of the cases.

We may next consider the symptoms of that part of the first group where a compensatory circulation has been established, which breaks down at a later date, causing or contributing to a fatal outcome. Naturally when the intestinal infarction finally occurs the symptoms will be those described above, but are there any symptoms during the period of compensation?

It will be remembered that the establishment of a collateral circulation is in large measure due to the lowering of peripheral resistance caused by a dilation of the anastomosing arteries and of the stream bed. Further, that the proper functioning of this new arrangement is dependent on the maintenance of an adequate cardiac compensation, adequate anastomotic channels (arteries that have not been too much injured by disease), and diminished pressure in the peripheral stream bed. Where all of these factors remain competent, no symptoms will likely result. In this group, however, there are cases where the occlusion has been caused by a thrombus secondary to arteriosclerotic disease of the mesenteric vessels, and judging from the few cases that have been described they are apparently in the majority. Owing to the nature of the pathological process, these patients may show symptoms even during the stage of compensation.

In 1901 Schnitzler described the following case:

A woman, age 55, for 5 years had been suffering from marked constipation. During the last 4 of these 5 years the constipation had been accompanied by attacks of colic-like pain in the right hypochondrium and epigastrium. Until one-half year before he saw her, the pain often had occurred after meals and had been relieved by vomiting. Since then, however, the vomiting had ceased and the pain which now occurred under the region of the umbilicus had become very much more severe. It now had no relations to meals and during the last few months had been almost continuous. Without a definite diagnosis an exploratory operation was performed. Gall-stones were found and a cholecystectomy was done. The intestinal tract showed no abnormalities. This operation had not the slightest effect on her pains. They continued without interruption until 6 weeks later when, after growing much weaker, she died.

At the autopsy there was found an hæmorrhagic infarction of the small intestine and in the superior mesenteric artery a thrombus 1 centimeter long. This was firm and fibrous and of many months' duration in spite of the recent intestinal infarct. The microscopic picture showed arteriosclerosis of the superior mesenteric artery and its branches.

This is evidently a case where a collateral circulation had been established concomitant with the gradual closure due to thrombosis, but where it had broken down before death. More interesting to Schnitzler were the attacks of colic and constipation occurring during the 5 years preceding death. He reasoned that if owing to an insufficient blood supply

due to arteriosclerosis the muscles of the extremities could not properly function, but rapidly developed pain and fatigue after exercise, then this same picture could occur in the intestine if it were called on to function in the presence of arteriosclerotic vessels. His argument seems perfectly sound. At rest there is no pain. But after a meal, with the advent of work, violent pains set in. It is also interesting to note the fact that marked constipation existed in Schnitzler's case. It will be remembered that with closure of the superior mesenteric artery the abolition of peristalsis—the loss of function—was one of the possible sequelæ, and that in one case of arterial closure, that of Councilman, death occurred from intestinal obstruction and no evidence of infarction was found. It is probable that in these cases of mesenteric sclerosis the inferior mesenteric artery as well as the superior is involved. A similar effect may, therefore, be produced upon the descending colon.

It may have been noted that arteriosclerosis and not thrombosis was referred to above. But the effect varies only in degree. The arteriosclerosis, if sufficiently severe, prevents adequate blood supply to the part, and with a complete obliteration, caused by a thrombus on a sclerotic plaque, the effect is similar but much more marked. There will also be recalled the cases where infarction occurred even with incomplete closure of the arterial lumen.

This picture has been especially emphasized because of its importance yet apparent general neglect. On the Continent it has long been recognized and discussed but the American textbooks hardly mention it. It may be that some exploratory operations for gastric ulcer, cholelithiasis, and chronic appendicitis would not be performed were this symptom-complex kept in mind. How closely the picture may resemble that of peptic ulcer is shown by a case of Warburg's.

A man, age 51, presented himself with the following history. Eight years before admission he suffered from headaches which disappeared after a year. He was then seized with attacks of severe abdominal pain referred to the region of the umbilicus. These were subject to remissions and in the intervals he felt perfectly well. At first the pains came on 2 to 3 hours after meals. They were often marked at night. Later they came on at any time. Accompanying these pains were attacks of very obstinate constipation that yielded to no cathartics but only to enemata. When he took light foods he was less liable to these attacks and the pain was less intense. For the last few months before admission the attacks had been accompanied by vomiting. Physical examination showed tortuous temporal arteries and palpable radials, an enlarged heart, a systolic blood pressure of 125 millimeters mercury. Exceedingly interesting was the fact that in the morning his abdomen was flat, but that after eating distention along the line of the ascending and transverse colon manifested itself. X-ray examinations and gastric test meals proved entirely negative.

The pains coming on after meals often marked at night, the remissions with periods of well-being, the long history of seven years are all very suggestive of peptic ulcer. The vomiting and the fact that the pains were less severe with a light diet also tend to confirm that diagnosis. From what has been stated above it will be recognized, however, that these pains were the pains akin to intermittent claudication. The obstinate constipation accompanying the attacks will also be familiar. The arteriosclerotic temporal and radial arteries suggest the possibility of a similar condition in the mesenteric arteries. It should be remembered though that sclerosis of the splanchnics may be present without palpable changes in the radials or temporals, and as in this case, without increase in blood pressure. In eliciting the history careful inquiries should be made concerning pains in the precordial region brought on by exertion and for like arteriosclerotic phenomena in the other organs. The above mentioned individual admitted that exertion brought on such precordial pains, but the abdominal condition was so much more severe that he paid little attention to them. In nearly all of the described cases the abdominal distention, especially during the attacks, has been a marked feature. The pain is referred usually to the region below the umbilicus. X-rays of the gastro-intestinal tract and gastric test meals are of course negative as far as the diagnosis of ulcer is concerned.

There remains now that part of the first group to consider where a compensatory circulation is established and persists through-

out life. The obliteration of the mesenteric vessel is discovered at autopsy if some other finding prompts its examination or if these vessels are examined as a routine. Unless the circulation is at times partially inadequate as in the arteriosclerotic type mentioned above, there are no symptoms whatever. Where too the obliteration of the mesenteric vessel has been gradual, as by the pressure of an aneurism, we would expect no symptoms pointing to the change. But it will be remembered that in some cases the obliteration is caused by an embolus and is therefore sudden. In spite of the fact that a competent collateral circulation has finally been established, the facts mentioned above must point to the expectation that quite a pathological commotion must have been aroused by the lodgment of the embolus. And the symptoms produced would be similar to those detailed above as occurring with intestinal infarction, except that they probably would not be so severe, and recovery would ensue. Karcher's case, already mentioned above, illustrates this well.

In his case the liberal distribution of emboli from the heart to the different organs had evidently been a long standing affair. During the attack observed in the hospital emboli had almost simultaneously found lodgment in the superior mesenteric artery and in the left profunda femoris. The abdominal symptoms were precisely similar to those we would expect with infarction, and the bloody stools which were present make it certain that a lesion of at least the mucosa was produced. It will be remembered that in the experimental work, in the non-fatal cases, the mucosa always suffered first and most, and that often it alone was involved. The establishment of the collateral circulation permitted the healing of what lesion had been produced, and 6 weeks later only a slight reddening of the mucous membrane in the ileum was noted.

The especially significant fact which should again be emphasized is that symptoms of intestinal infarction occurred, but that spontaneous recovery resulted. Further, that these symptoms were actually produced by an embolus of the superior mesenteric artery which was found at autopsy. This is incontrovertible proof that sudden closure of the superior mesenteric artery, even though accompanied by the typical symptoms, is not necessarily fatal and may be followed by spontaneous cure, or stated in other terms, *a favorable outcome without operation does not necessarily exclude the diagnosis of embolism or thrombosis of the superior mesenteric artery.*

This statement coming after all the experimental work mentioned above and after the cases that have been cited will not sound very startling. But it certainly does not seem to be very widely appreciated. There is no report available in the American literature of a case in whom without operation it was suspected that a closure of the superior mesenteric artery had occurred with spontaneous recovery. Several cases are reported in the English and German periodicals. An abstract of these will be found at the end of this article. To these cases another will presently be added.

Just a few words are given concerning the symptoms of closure of the branches of the superior mesenteric artery. The possible results of such a closure have already been considered, and the symptoms that follow will depend on the particular effect that it has produced on the intestine. The same groups of symptoms as given for closure of the main trunk will, therefore, hold here.

1. The collateral circulation is not established. Infarction results and produces the symptoms detailed above.

2. The collateral circulation is effectually established. (a) In one group the compensation remains effective throughout life and death occurs from some unrelated cause. The symptoms will depend on whether a lesion of the intestine has or has not preceded the complete establishment of the collateral flow. If a severe injury of the muscularis and mucosa has been produced before the compensation is adequate, grave symptoms, indistinguishable from those of infarction, result. To this group belongs Ross' case described at the end of this paper. If there is an immediate re-establishment of the circulation without the production of an injury to the intestine no effect follows.

(b) In the second group compensation after being established and functioning effectively for a period of time, subsequently breaks down and produces an infarct. This breakdown is due either to aggravated arterial disease, as in the case of splanchnic sclerosis, or to severe cardiac decompensation. During the compensatory stage, prior to the breakdown, the atherosclerotic cases—depending on the severity of the process—may show the symptoms of splanchnic sclerosis (intermittent claudication) described above. The cardiac cases will probably have no symptoms.

A few things should be emphasized however. It must be clear that the tendency with sudden or gradual closure of the branches of the artery is for a re-establishment of the circulation and hence little or no disturbance in the intestine. With the larger branches at times infarction results, but the unquestionable tendency is in the opposite direction. There can be no doubt that in some of the cases of valvular disease where emboli are liberally distributed to the organs—perhaps from auricular thrombi—some find their way into the branches of the superior mesenteric artery. And it must be true that the large number of these give little or no symptoms and are never suspected. It may be though, that occasionally because of a weak heart, or because the embolus is arrested in a large branch, some difficulty is experienced in re-establishing the circulation and a non-fatal lesion of the mucosa or muscularis and mucosa is produced—a lesion that subsequently goes on to healing. Careful questioning of such a patient would elicit a history of a single or of multiple attacks of abdominal pains perhaps accompanied by obstipation or diarrhœa. Bloody stools too may have been present. And these symptoms occurring in a case under treatment should strongly suggest the possibility of a vascular occlusion. Many of these cases of closure of the branches would certainly be found postmortem if they were sought for. They must be far more common than we suppose.

To the cases of mesenteric vascular occlusion with spontaneous recovery the following one is added.

W. B., a private patient of Dr. A. A. Berg, age 61 years; while crossing the street was thrown down by an automobile and sustained a fracture of the base of the neck of the left femur. Sixteen days later he was admitted to the hospital. Owing to his age and his poor general condition it was deemed most advisable to immobilize his left lower extremity between long sandbags and to keep him propped up high on pillows. Three weeks later, on the thirty-eighth day after the fracture, because of the fear of keeping him longer in bed, he was permitted to sit up in a wheel chair, although firm union had not occurred between the ends of the fractured fragments. The next day he complained of severe pain in the lower part of his right axilla and at the same time developed a cough. No definite change could be made out by percussion over this area, but auscultation revealed diminished breath sounds. During the next few days these symptoms grew less marked and they were soon overshadowed by the following developments.

On the evening of the forty-second day after the fracture he was suddenly seized with violent abdominal cramps, generalized over the entire abdomen. Slight distention too was present. An enema was given but proved ineffectual. The following morning the distention had become quite marked and in the evening he began to vomit. He still complained bitterly of colic-like pains. All enemata proved entirely ineffectual, no fæces or gas being expelled. Turpentine stoops too were without avail. Toward evening the vomitus which was frequent and profuse became bloody. Tenderness which had at first been general, now became localized in the right lower quadrant. Here too what felt like a thickened loop of intestine was palpable. There were no signs of an external strangulated hernia, and physical examination was otherwise negative. The temperature was normal. Operation was advised, but the patient absolutely refused.

The next morning—the second after the onset—the patient seemed much weaker. Hiccoughing began and persisted as a very annoying symptom. Vomiting continued and was "coffee-ground" in nature. Passage of a stomach tube brought back 20 ounces of such fluid. On the afternoon of this day, 44 hours after the onset of the symptoms, an enema finally proved effectual. A large amount of flatus was expelled, and with it a copious amount of "coffee-ground" fluid of the same nature that he was then vomiting. The chemical test for blood was positive. His temperature all this time ranged from 98.4° to 99.8°. On one occasion it was 101.4°, but dropped in 4 hours to 99.8°. The temperature was taken every 4 hours by rectum.

From this time on stools became exceedingly frequent and often involuntary. They were very profuse and contained the above mentioned "coffee-grounds," but no fæces. Gas was expelled freely, but distention persisted. Vomiting also continued.

On the fourth morning after the onset he was very weak indeed. Fluid was administered to him

by hypodermoclysis. His pulse was weak, ranging between 120 and 140. His rectal temperature ranged between 97.6° and 100°. The distention was less marked. The mass in the right lower quadrant could no longer be made out. His condition seemed so bad that no hope was entertained for his recovery.

Two days later the vomiting had almost stopped and the stools had become infrequent. He began to take small quantities of fluids by mouth. From this time on he slowly improved. He left the hospital 101 days after his accident and 59 days after the onset of the above symptoms. He was then walking on crutches and his fracture had united.

We have then a picture of an acute intestinal obstruction lasting 44 hours, with bloody vomitus, and after that profuse and watery bowel movements also containing blood. Such a picture at once suggests the diagnosis of occlusion of the superior mesenteric artery or vein. The violent colic, the distention, the presence of a palpable coil, and the absence of temperature, all tend to confirm that view.

The only other diagnoses that seem possible are intussusception, spontaneous reduction of an internal strangulated hernia, or spontaneous reduction of a volvulus.

Intussusception at this time of life is usually due to a pedunculated intestinal tumor. It is very unlikely that an intussusceptum with a tumor at its apex would spontaneously reduce. And even though this had occurred the continued growth of the tumor would finally give symptoms. This man is perfectly well now over a year from the date of his illness and without any signs of obstruction. Furthermore in intussusception small amounts of blood and mucus are passed through the rectum. In the above case there was complete obstruction followed by copious watery movements containing blood.

The second possibility mentioned was spontaneous reduction of an internal strangulated hernia. After a loop of intestine has slipped through a hernial ring, strangulation is effected by constriction of the blood supply. This constriction is probably at first only sufficient to obstruct the return flow in the veins where the pressure is low. A venous engorgement naturally follows in the imprisoned loop causing it to enlarge in volume, and gradually to compress the artery and shut off its flow. After a constriction which has produced the changes mentioned above, and which has persisted long enough to cause a fairly severe intestinal lesion, it is very unlikely that such a swollen loop could spontaneously reduce through the same ring which is causing the constriction. One need only mention the difficulty of reducing a strangulated inguinal hernia without first dividing the constricting ring. It seems hardly probable that this phenomenon occurred in the above patient.

The third possibility was spontaneous reduction of a volvulus. Here there may be primarily only an intestinal obstruction—which, of course, if unrelieved results in death—or there may be in addition a constriction of the blood supply of the affected loop. If the symptoms in the case described above were produced by a volvulus, some interference with the vascular flow must have existed for the profuse bleeding indicated an intestinal lesion. Volvulus most often occurs in the sigmoid loop and one readily recalls what an enormous size this loop attains due to imprisoned gas. Venous engorgement following obstruction of the blood supply further adds to its volume. It seems unlikely that such a tremendously swollen loop could spontaneously untwist itself within the crowded confines of the abdomen.

As regards the cause of the mesenteric occlusion, that may, of course, have been effected by closure of the artery or the vein. It is very unlikely that the vein was at fault for, in the first place, all of the usual etiological factors, such as an inflammatory lesion in some part of the body, were apparently absent. Secondly, the pathology of intestinal infarction due to venous closure makes it probable that every case must terminate fatally except those saved by operative intervention. With venous closure infarction as a rule only occurs when the thrombus has grown down in the terminal arteries to the intestinal wall. That naturally precludes the establishment of a collateral circulation, for in the experiments above noted it was found that the collateral circulation in the submucosa was only effective over a distance of from 3 to 5 centimeters.

It is probable then that the lesion in this case was produced by arterial closure. That, of course, opens up the possibility of a thrombus or an embolus. Thrombosis usually occurs in the arteriosclerotic cases. This man had a blood pressure of 138–80. His temporal arteries were not visible, his radials were not palpable and his urine was negative. His heart was not enlarged, there were no murmurs, and there was no accentuation of the aortic second sound. Nevertheless, inasmuch as sclerosis of the aorta and of the mesenteric vessels may occur in spite of all such negative findings, a thrombus cannot be definitely excluded as the causative factor.

It seems more probable, however, that the lesion was produced by an embolus. Often the source of an embolus cannot be definitely located, but most commonly it comes from the heart or from an arteriosclerotic plaque in the aorta. As there was no evidence of a cardiac lesion it seems unlikely that the embolus originated in the heart. An aortic plaque cannot be absolved from responsibility, for it is impossible to exclude arteriosclerosis. However, as already stated, there were no signs which permitted a diagnosis of the presence of this condition.

One other source seems very suggestive, and that is a fat embolus originating from the fractured femur.

Fat embolism, Warthin complains, is a subject the importance of which is little appreciated. During recent years much interest has been revived in it as being a possible explanation of some types of shock. It is almost certain that accompanying every injury to the long bones there is a discharge of fatty emboli into the blood stream. This fat at first finds lodgment in the lungs, where it usually gives no symptoms. Occasionally however, typical symptoms of pulmonary embolism are followed by collapse and death and postmortem examination shows the lung capillaries choked with fat. In the non-fatal cases the fat does not remain in the lungs but passes through the capillaries into the general circulation and is distributed to all the organs. It occasionally makes known its lodgment in the brain by giving symptoms of cerebral embolus with a usually fatal result. The kidney does not retain the fat which reaches it, but excretes it into the urine. Fat may be found in the urine on the second, third, or fourth day, following a fracture. The fat which has become lodged in the capillaries of the viscera after a time manages to pass through them and again is carried back to the lung, which in turn permits it after some days to again pass into the general circulation. According to Scriba there are usually two such cycles, but occasionally three or even four. Fat may be detected in the urine on the second to fourth day after the injury, on the tenth to fourteenth, and sometimes once or twice after that. Most of it is finally passed out through the urine. Another diagnostic sign recently described by Warthin is the presence of fat in the sputum. It is found microscopically as free fat droplets or in the alveolar cells.

A large number of cases have now been reported where fat embolism has caused death with cardiac, pulmonary, or cerebral symptoms. In the absence of infection it is an exceedingly probable cause of death in all operations on, or fractures of, the long bones, and is most likely responsible for many symptoms that are attributed to shock. (Warthin).

Experimentally the injection of fat into the circulation gives the same results as those outlined above. The animals that die or are killed show infarcts usually in the lung, brain, and spinal cord, and fat with or without infarcts in all the other organs. Most of the attention in all this work was directed to the lungs, central nervous system, and the heart. But in several of his animal experiments Scriba mentions capillary apoplexies in the intestine. In many cases the mesenteric capillaries were full of fat (Cases 23, 26, 28 of Scriba's series).

That fat, therefore, found its way into the superior mesenteric artery of the above described patient with fracture of the femur cannot be doubted, but whether fat caused the symptoms of infarction on the forty-second day after the injury is harder to say. It will be remembered that the injection of oily substances into the superior mesenteric artery,

in order to produce artificial emboli, was constantly followed by infarction of varying extent. Of course, here large quantities were directly introduced into the intestinal circulation. It will also be remembered that severance of the mesentery from the intestine for a distance of 5 centimeters produced ulcerations of the mucosa but not death. If done to a larger area infarction and death resulted. It is possible that in the case described above the terminal mesenteric vessels over a contiguous area of approximately 5 centimeters were blocked and a lesion thus produced, a lesion not involving all the coats, possibly only the mucosa, and which had finally gone on to healing just as in the animal experiments.

A further objection might be raised in that these symptoms took place 42 days after the injury, but Connell describes a case of fracture of the lower third of the femur, treated by Buck's extension method, which showed a similar phenomenon.

On the fifteenth day the patient developed shortness of breath, cough, and pain in the left chest. The material expectorated contained blood, and fat was found in it by microscopic examination. Physical examination showed consolidation at the base of each lung. Fat persisted in the urine for one week. On the forty-second day he was permitted to sit up in a chair for one hour in the morning and a similar period in the afternoon. On the evening of the next day he again showed signs of a pulmonary embolus. He complained of difficulty in breathing and pains in his chest. Subnormal temperature, dyspnœa, cough, and pain persisted throughout the next day. Fat was again found in the sputum and in the urine. The symptoms took 6 days entirely to disappear.

Here we have a pulmonary fat embolus occurring 42 days after the fracture and 2 days after the patient was permitted to sit in a chair, even though the fragments had united. In the case described above the symptoms occurred on the forty-second day—3 days after the development of a cough and pains in the axilla. It seems possible that the chest condition may have been due to a pulmonary embolus, and that the subsequent intestinal symptoms were caused by fat which had passed through the lung capillaries and found lodgment in the vessels of the intestine. It is unfortunate that the urine was not examined for fat. In connection with the late occurrence of fat emboli after a fracture it may be mentioned that experimentally a severe blow on a long bone is followed by the liberation of fat into the circulation. And the case described by Beitzke shows that the same thing may occur in man and lead to a fatal termination. It does not seem improbable that a jar incident to lifting a heavy man from bed into a wheel chair produced the same effect, especially in the presence of an incompletely healed fracture.

## TREATMENT

To consider the treatment the cases may be subdivided into two groups: first, those with splanchnic sclerosis with or without thrombosis, and second, those with mesenteric infarction.

The difficulty, of course, in the less severe cases of splanchnic sclerosis is that the intestine when at work cannot properly function in the presence of an inadequate blood supply. In the more advanced cases pain is constant, as is shown in Schnitzler's case referred to above. It would seem logical then to give as little work to the intestine as possible. Small frequent meals and readily digestible food are, therefore, indicated. The pains, it will be remembered, were usually most marked after heavy meals and not so severe or absent after light ones. In the German literature much emphasis is placed on the use of diuretin. Warburg regards it almost as a specific, and says that it may even be used as a therapeutic test to confirm the diagnosis.

For mesenteric infarction there is but one treatment and that is, excision of the infarcted intestine and re-establishment of its continuity. Since Elliot first performed this operation in 1895, about 24 successful resections have now been reported.

There will be a group of cases in which, because of the history and attendant circumstances, a mesenteric embolus is suspected, but in which the symptoms are not very severe, or in which though severe they rapidly subside. These cases will of course be familiar. Here it may be justifiable to wait, and a favorable outcome does not invalidate the diagnosis. But where the severe symptoms of infarction are present, notably those of unrelenting

intestinal obstruction, or where there is any doubt as to the extent of the lesion, operation is indicated. And with the patient in fairly good physical condition it would appear safer if this diagnosis is suspected to subject him to an exploratory laparotomy, rather than to wait until operation can hold out little chances of success. Palliative treatment should be reserved only for those cases where the physical condition does not warrant the shock of an operation or where consent is refused. And though death will be the usual outcome of such treatment, it should be known that at rare intervals some individual like the one described above will struggle back to this life from what looks like the brink of the grave.

SUMMARY

1. Occlusion of the mesenteric vessels is most often effected by an embolus or a thrombus.

2. Experimentally, by varied disturbances of the intestinal blood supply, there may be produced lesions varying from limited necrosis of the mucosa to extensive infarction of all the intestinal coats. The milder lesions are not fatal and heal completely.

3. It seems likely that these experimental findings are closely paralleled by the lesions in man.

4. Closure of the superior mesenteric artery in man may be followed by—

a. Complete establishment of a competent collateral circulation which will (1) persist effectively throughout the patient's life, or, (2) subsequently break down, usually because of aggravated disease of the heart or the blood vessels;

b. Intestinal obstruction without infarction owing to a blood supply sufficient for life of the parts but not for function;

c. Intestinal infarction, with the injury varying through all stages from a moderate lesion of the mucosa to pronounced necrosis of the intestinal walls.

5. Following obstruction of the trunk of the artery the third effect noted above is the most common.

6. Following obstruction of a branch the first effect is the most common.

7. The patients in group three present the symptoms of intestinal infarction. The presence of a logical cause for occlusion of the mesenteric vessels, the sudden onset of shock and violent abdominal pain, the symptoms of intestinal obstruction, preceded or accompanied by bloody vomitus or stools should strongly suggest the possibility of such infarction.

8. In group two there are the symptoms of intestinal obstruction without any apparent cause.

9. In group 1 (b) during the stage of compensation there may be no symptoms. On the other hand in the arteriosclerotic cases, symptoms parallel to those of intermittent claudication may be present. The picture closely resembles and may be easily confused with that of peptic ulcer.

10. In group 1 (a) symptoms may have occurred at the time of the establishment of the collateral flow. These may be mild or, on the other hand, indistinguishable from those that occur with the fatal cases. They are dependent on the severity of the lesion produced.

11. The symptoms produced by closure of the branches parallel those given above for the main trunk. Here, however, most commonly no lesion is produced. Consideration of the etiology and pathology makes it certain that many non-fatal cases occur which are never recognized and which could be found at autopsy if sought for.

12. A favorable outcome without operation does not exclude the diagnosis of embolism or thrombosis of the superior mesenteric artery.

CASES OF MESENTERIC OCCLUSION WITH SPONTANEOUS RECOVERY

Moos. A 19 year old medical student suffering from acute ulcerative endocarditis, and in whom previous embolic phenomena had manifested themselves in the shape of transient attacks of haziness of vision, subcutaneous ecchymoses, and a popliteal embolus, was seized with a sudden attack of severe abdominal pain. Accompanying this were many hæmorrhages from the bowel which lasted for 4 days and then stopped. After a few days, however, the severe colic and hæmorrhages recurred, again lasting 2 days. Following this the patient slowly recovered. The history of other emboli, the sudden abdominal colic, and the bloody stools make

it very probable that a mesenteric embolus was responsible for the above symptoms.

Finlayson. The patient was a married woman aged 45 years and suffered from aortic valvular disease. A hemiplegia of the face and arm had occurred 1 year before the symptoms presently to be described. On April 7, 1887, at 1 p.m. she was seized with severe pain in the left arm and severe pain in the epigastrium. She went into collapse and her extremities were cold. Loss of the radial pulse was noted. Eight hours after the onset she began to pass large quantities of blood in her stool. Severe pain in the arm and epigastrium continued. The abdomen was distended and tender. These symptoms gradually subsided and the patient recovered. The presence of a source for emboli in the heart, the history of a previous embolic phenomenon, the discharge of an embolus to the left upper extremity at the same time that severe abdominal pains occurred accompanied by collapse and abdominal distention, make this almost certainly a case of embolism of the superior mesenteric artery.

Aufrecht. An 8 year old girl was admitted to the hospital with a history of vomiting and severe pain in the right side of the abdomen for 3 days. On the day of admission the vomitus consisted of almost pure blood. Physical examination showed that the abdomen was markedly distended and everywhere tender, the tenderness being most marked in the right hypochondrium. Here too an indefinite mass was felt. The heart was enlarged both to the right and to the left and a loud systolic murmur was present over the base. The temperature was normal. These symptoms persisted for 2 days and then she had a spontaneous stool containing blood. Severe colic, abdominal distention, and numerous bloody black stools lasted 3 more days. From then she slowly recovered. The heart lesion, the sudden onset of the abdominal symptoms, the vomiting of blood, the severe colic with distention persisting in spite of the later evacuation of numerous thin bloody stools, and further no rise of temperature, all tend to make this a case of mesenteric embolism.

Ott. Case 1. A 42 year old man while in the hospital under treatment for cardiac decompensation, developed all the typical symptoms of a pulmonary embolus. On the following day he was seized with severe abdominal pain and went in to shock. His temperature dropped to 36.5 C. Bloody stools then followed. He slowly recovered. No details are given of the abdominal findings. There are present, however, a potential cause for the production of emboli, the symptoms of a pulmonary embolus, severe abdominal pain, sudden in onset and accompanied by shock and drop in temperature, and very significant, of course, the bloody stools.

Ott. Case 2. The patient was a 50 year old man presenting symptoms of marked arteriosclerosis and cardiac hypertrophy. He had also a history of a hemiplegia on the left side, acute in onset and occurring a few days before admission. Seven days after he entered the hospital he was seized with severe abdominal pain and a short while later passed a stool of almost pure blood. He went into collapse and his temperature dropped to 36.4°C. Several bloody stools followed the first one. His bowels then did not move for 2 days, but following an enema a bloody mucous stool was evacuated. The blood persisted in the stools for 5 days. The patient then gradually recovered. Ott believed the cerebral and abdominal condition to be due to emboli. In view of the pronounced arteriosclerosis of this patient the source for these emboli might very well have been from an ulcerated plaque in the aorta. On the other hand the lesions may have been produced by arteriosclerosis and thrombotic closure of the affected vessels. In the case of the intestine, at any rate, this does not seem so likely. Closure by thrombosis is usually a slow process (unless a clot rapidly forms on a thrombus and thus effects a closure). Hence much time is given the collateral circulation to establish itself. If, therefore, in spite of this fact symptoms of infarction should arise, it probably means that the anastomosing channels themselves are so injured by the same pathological process that a compensation flow cannot be established through them.

Bayer. A man 58 years old had been suffering from prolapsing hæmorrhoids. These could always be easily reduced until the day before admission when, because of the fact that they were greatly swollen, he replaced them with difficulty. On the next day he developed severe pain in the left side of his chest and expectorated bloody sputum. Bayer believed these symptoms due to a pulmonary embolus. Two days later he was seized with violent pain in his right lower quadrant. From this time his bowels became obstructed. On the next day vomiting started. These symptoms of absolute obstipation, without the passage of fæcal material or flatus, lasted for 3 days. Physical examination during this time showed tenderness in the right lower quadrant and marked abdominal distention. A thrombosed hæmorrhoid was present. On the fourth day after the onset he had a spontaneous stool without blood. Bayer believed the abdominal symptoms due to a mesenteric occlusion produced by an embolus from the lung. The pulmonary infarct in turn he believed due to an embolus liberated from the thrombosed hæmorrhoid by the manual manipulations while attempting to replace it. Such a diagnosis seems very plausible. There is a source for the embolus, and also sudden onset of obstipation. The absence, however, of marked symptoms of shock and the absence of blood in the vomitus and stool prevent the diagnosis from being made with more certainty.

Trotter. This case is somewhat doubtful. A patient being treated for "a septic condition of the hand" developed thrombosis in all the cutaneous veins of the forearm. This gradually subsided, and 6 weeks later he was seized with a chill and complained of pain in his chest. A slight cough de-

veloped and he expectorated some blood. Examination showed complete dullness over the base of the right lung, and absence of breath sounds. Five days later the chest signs were gone. One week after the development of what looked like a pulmonary embolus he developed diarrhœa and tenesmus, with great pain in the lower part of his abdomen. Later he had a chill which was followed by nausea and vomiting. There was no blood either in the vomitus or stool. The abdomen was somewhat distended and tenderness was generalized over the lower part. Most of the symptoms rapidly subsided, the diarrhœa and tenesmus with involuntary stools persisting for about 4 days. After this the patient soon was perfectly well. It may be that an embolus was carried from the lungs to the superior mesenteric artery or one of its branches and produced the above symptoms. However, such a diagnosis must remain open to doubt in view of the following facts. There was a chill at the onset and hence presumably a rise of temperature. No temperature observations are mentioned. There was no blood at any time in the vomitus or stool. Pain does not seem to have been a prominent and persistent symptom. And further the tenesmus and diarrhœa which predominated the picture seem rather to point away from this diagnosis.

Laws. In this case an operation was performed, but as it consisted merely of an exploratory laparotomy, it would seem proper to include the case here. A 10 year old boy was suddenly seized with acute abdominal pain and vomiting. Soon after he went into collapse. Following a dose of calomel a large quantity of blood was passed by rectum. This was followed by two small bloody stools. The colic-like pains and vomiting persisted. The abdomen was moderately distended, decidedly rigid and tender, especially in the right lower quadrant. The temperature was normal. At the operation a considerable quantity of bloody fluid poured out of the abdominal cavity. Two feet of small intestine were found "distended, œdematous, and purplish in color." Delivery of this loop seemed to straighten out an obstructing kink at the distal end, which was, however, regarded as secondary, rather than the cause of the trouble. The mesentery was full of hard lymph nodes of various sizes, probably tuberculous. The "mesenteric veins corresponding to the damaged segment were thrombosed." Owing to the poor condition of the patient and to the technical difficulty of performing a resection under the existent circumstances, Laws contented himself with closing up the abdomen. The patient continued to vomit for 2 more days and then the symptoms rapidly cleared up and he recovered.

This case is very interesting. While the entire description is not as full as it may be, nevertheless there does not seem much doubt that a condition of beginning infarction was present. As Laws suggests it is very probable that the "obstructing kink" that he mentions was secondary. The blood in the stools could only have come from the purplish area in the intestine. And as the kink was beyond this area, the obstruction which it caused was either incomplete or occurred after the intestinal lesion was well under way. The statement concerning the thrombosed veins is very interesting. If he accurately determined at the operation that only the veins were blocked and that the arteries were patent, it would seem at first glance that this was a refutation of Reich's conclusion that fatal infarction occurs when the thrombus in the veins extends down to the intestinal walls. However, Laws makes no mention of the extent of the thrombi, merely stating that the veins corresponding to the damaged segment were thrombosed. At any rate here is a definite case of beginning infarction due to vascular occlusion which spontaneously recovered.

Ross. A patient 51 years old was admitted to the hospital with the following history. On the day before admission he was seized with severe pain in the epigastrium which soon became generalized to all parts of the abdomen. The pain was paroxysmal in character and a dull ache persisted in the intervals. The bowels had not moved and vomiting had occurred several times. Physical examination showed that while the epigastric and right iliac regions were tender, the maximum tenderness was present in the left upper quadrant. The fluid return when the stomach was lavaged was fecal in character. At operation a thrombus was found in a branch of the superior mesenteric artery supplying the ileum. Hæmorrhages were present in the mesentery and there was a small amount of free blood in the peritoneal cavity. In the opinion of the operator (Dr. J. B. Deaver) the segment of bowel supplied by this occluded vessel was in fair condition, and apparently being taken care of by the collateral circulation. The abdomen was therefore closed without any further procedure. The patient recovered. Here is excellent evidence that a closure of a branch of the superior mesenteric artery was followed by sufficient changes in the intestine to cause complete obstruction. Nevertheless a collateral circulation was subsequently established spontaneously.

I wish to extend my kindest thanks to Dr. A. A. Berg for permission to report his case and for considerate and helpful suggestions in the preparation of this paper.

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# IS THE SURGEON OF EXPERIENCE EVER JUSTIFIED IN VIOLATING THE RECOGNIZED SURGICAL TECHNIQUE IN DEALING WITH MALIGNANT NEOPLASMS?[1]

By L. L. McARTHUR, M.D., F.A.C.S., Chicago

ONLY after mature deliberation (and even then with considerable hesitation) has the essayist decided to take the affirmative side in the query submitted, because in the course of 40 years' experience in a relatively few but carefully selected instances, he has, by so doing, spared his patient extensive, painful, mutilating procedures, which the subsequent history of the case has proven, were, *in these instances*, wholly unnecessary.

Teachers of surgery, basing their teachings on their combined experience have formulated certain set rules and procedures, which are emphatically and categorically set before the student as the *only justifiable* and recognized technique permissible in the handling of malignant growths in certain given situations. So constant, so unanimous, and so insistent have these teachings been, that he is indeed bold who dares depart from the accepted routine. He lays himself open to frank condemnation by his colleagues should the question become a medico-legal one, so inflexible is the present attitude of the general surgeon. The recent graduate would have little hesitation in pronouncing as criminal any departure from the recognized formulæ. While it always will be highly desirable to be clear, concise, and emphatic in teaching *surgical students* the laws that shall govern the given situation, there should exist, as does not now obtain, certain rare occasions when the *surgeon* should be exempt from (a) criticism by his colleagues; (b) medico-legal damages made possible by such condemnation.

Let it be well understood that the patient and his family have been carefully and fully informed as to the contemplated departure from the recognized and accepted methods, and his or her agreement likewise obtained as to hearty and persistent co-operation in the subsequent watchful observation.

Let me herewith submit as illustrative of the argument being made, a few brief synopses of actual cases, in which I have had the temerity to violate one or more of the accepted surgical axioms. All of the cases cited have been first confirmed by microscopic examination by our foremost pathologists as to their malignancy, all of them have passed the three-year period before pronounced cured, and from that up to 18 years.

C. H., age 55, referred to me by Drs. J. N. Hyde and Ormsby, for a carcinoma of the left side of the tongue, dorsal surface, which, beginning as a papilloma, was removed in their office first by caustics, and on recurrence by carbon dioxide snow: further recurrence rendered surgical removal advisable. A fragment removed at St. Luke's Hospital revealed typical epithelioma (Lecount). At the time of admission, no submental, sublingual, nor cervical glands were palpable, even by bimanual palpation.

Because the recognized technique *insists* upon the complete and radical removal of those lymphatic glands that exercise a police vigilance over the affected area, I ought, having resected the tongue, at least to have opened the left neck and removed the lymph glands known to be located at the points above mentioned; or if desirous of being most up-to-date to have made a "block dissection" of the entire left neck as taught at Johns Hopkins. In lieu of this, the patient was thoroughly informed of the possibilities of future trouble; of the imperative necessity of early recognition of any glandular invasion; of the need of his systematic co-operation in giving the surgeon ample opportunity for watching the case over such a period of time and as frequently as he deemed necessary. Result: No glands ever appeared; no neck surgery ever became necessary; and within 6 weeks of the operation the patient made a successful campaign for mayor of Chicago. Eight years have elapsed since operation.

Again –

S. L. S., age 50, a man of affairs, good physique, general history negative, no luetic history, heavy smoker, had long noted patches of leucoplakia in his mouth. Before being referred to me, an ulcerated, warty growth had appeared on the right side of his tongue, involving its margin and dorsum. This ulcer was treated for several weeks by the eminent dermatologist, the late lamented Joseph Zeisler—without avail. On the appearance of a

single large tender lymph gland near the angle of the jaw, the patient was referred to me. Section made of a fragment of the ulcer was reported by the pathologist at Michael Reese Hospital as carcinoma (planocellular). Wedge-shaped removal of one-third of tongue. The lymph node, of so recent origin, having made its appearance immediately following the active cauterization of ulcer with chromic acid, etcetera, was allowed to remain for observation. With the removal of the growth from the tongue, prompt reduction in the size of the single palpable gland ensued. Prophylactic raying with X-ray during the succeeding 6 weeks showed complete disappearance of node. No further operation necessary. Patient well 10 years!

Since the epoch-making report of Butlin of his two series of cases of carcinoma of the mouth (tongue or jaw), 98 cases with simultaneous removal of invaded lymphs, 102 cases with secondary removal of the affected lymph glands, 10 days to 3 weeks later, justification for the delay in removal of the frankly enlarged gland in the case just described, is found; because in the last series of 102 cases (an enormous experience for any one surgeon) his mortality was reduced, complications diminished, and longevity of his patients increased; his experience teaching him that however badly invaded the protective glands were, they still offered a better barrier to systemic infections, than none at all. After the wounds in the mouth had begun to granulate, the secondary removal of the glands in the neck was easier, less likely to be followed by systemic or local infections, far less shock to the patient than obtains with the combined operation.

Sometimes, as in this instance, they may be only inflammatory in character and disappear with the removal of the irritating focus.

The imperative surgical axiom in cases of carcinoma involving the bony framework of the lower jaw, taught without exception, is: "Complete resection of that half of the lower jaw invaded, from the mid-line or beyond to the neck at least of the mandible." To do less would invite immediate criticism.

At St. Luke's Hospital, 5 years ago, the uncle of my house surgeon, Dr. Klein, was referred to me by Dr. Thomas L. Gilmer for operation for a recent small growth involving the gum and alveolar process, and jaw, at the former site of the two lower right molar teeth. A definite gland immediately beneath the right tonsil was palpable. Microscopic examination of a fragment taken for examination was reported as carcinoma by Dr. LeCount. Dr. Gilmer kindly assisted me in the operation, which consisted in reflection of the entire cheek by an incision downward from the angle of the mouth to beneath the jaw, curving back past the angle. With this flap detached from the jaw and retracted upward, the entire right side of the jaw was accessible. Because of the recent origin of this growth and the slight involvement of the ramus, the electric saw was used to excise a rectangular section of the ramus, including the alveolar process, but leaving enough of the dense eburnated bone for a bridge below the site of the disease to maintain the integrity of contour of jaw and face. The fragment, with soft parts, alveolar process, and growth, measured 2 inches in length. The bridge of healthy bone was one-half inch in each diameter. Sixteen days after the operation, primary union having been secured, with incision almost invisible, the gland beneath the tonsil was then removed, the greatest care being taken to avoid tearing its capsule. Microscopic examination here revealed typical carcinomatous gland. Four and one-half years later, there was no sign of any recurrence, no facial deformity. He died last winter from a fracture of the skull from a fall on an icy sidewalk.

Here, the mere statement that the surgeon had failed to completely remove widely the entire thickness of jaw in front of, behind, and below the site of the carcinomatous invasion, would be quite sufficient to expose him to ridicule, contempt, and medico-legal mulcting, for he could scarcely find a colleague who would defend him when cross-examined on the witness stand.

Clinical experience had taught me that while the microscopical histopathology of a fragment taken for diagnosis from a tumor may reveal the cellular arrangements that characterize the most malignant of the sarcomata, if that neoplasm have a capsule or limiting membrane, be it ever so thin, these extremely radical procedures always approved as proper, may sometimes be ignored and the patient be spared both life and irremediable deformity or loss of limb. For example:

Eighteen years ago, the daughter of my dearest friend, at the age of 15, developed a tumor of the mental prominence, which, in growing, gradually deformed the chin into a rounded mass and began loosening the incisor teeth of lower jaw. This case also was referred by Dr. Thomas L. Gilmer, who agreed that surgical interference was absolutely necessary. Arrangements were made for operation, Drs. LeCount and Hektoen being present to pronounce on the nature of the fragment removed for

frozen section, their verdict to determine the type of surgical procedure indicated. Let me digress right here to express my appreciation of the many valuable contributions that have come to us through the dental surgeon in general, and particularly to Dr. Thomas L. Gilmer, than whom none better lives. At his suggestion, then novel to me, the soft tissues were separated from the chin by an incision within the mouth and the mental prominence exposed through the buccal orifice, the lower lip being stretched beneath the bony chin. On incising the bone over the tumor, a thin eggshell layer of bone was found to cover a firm spherical tumor, not bony, to be cut with a curette only with distinct effort, but yielding readily to a sharp knife. While the pathologists were freezing, sectioning, and studying the fragment first removed, it was found possible to shell out the entire mass, about the size of an English walnut leaving a smoothly lined bony cavity into which the roots of the incisors protruded; these roots Dr. Gilmer amputated. With a curette and a dental burr, the walls of this cavity were smoothed away until no suspicious area remained. Enough of the alveolar process remained to hold the right and left maxilla, as a bridge. At this juncture, the pathologists returned with the finding "giant-celled sarcoma." Observing that no preparations were being made for a radical resection of the lower jaw, inquiry was made by them as to whether it would be done. Receiving a negative answer, we were then asked if we doubted the findings: again a negative answer. Both Dr. Gilmer and I had seen similar growths similarly removed without radical resection of the jaw; and though under the microscope malignant, clinically not invading but expanding the bone and causing pressure absorption. These had proven amenable to less heroic surgical procedures. Four years had to intervene before we felt justified (when considering the pathologists' findings) in making a plastic operation, by a graft taken from the patient's tibia and inserted beneath the skin that formerly covered the mental prominence. This became more necessary, because after 2 years the alveolar bridge fractured while chewing some brittle food. Later, implantation of adipose tissue taken from the patient's body and inserted beneath the skin of the chin served to correct in part the deformity caused by the 3 years of anxious waiting, to prove the cure of the original growth by a non-radical procedure—years which, if the light we now have, had been ours, could have been utilized to avoid much of the subsequent deformity, by earlier plastic work.

Eight and one-half years ago, there came to me from Texas a patient—Mrs. D., married, thin, with a frank carcinoma of the right breast with extensive right axillary involvement. A radical excision of the breast and pectoral muscles with careful dissection of axillary glands was made and a primary union secured. Prophylactic X-ray was used for 3 years, without evidence of recurrence. Two years later, i.e., 3 years ago, patient returned with a small node in the inner margin of the *left* breast, of size of small hazelnut. This she had discovered less than 30 days before, and felt confident it had not been there longer. Her former experience had made her both cautious and observing. With this history and with a thorough explanation of the situation to the patient, I advised her to let me make a simple removal of the growth under local anæsthesia by a small wedge-shaped incision, not removing the breast, not disturbing the left axillary glands, *unless some evidence presented* later making this advisable. Three months ago, I received the following note brought by the patient from Dr. W. A. Pusey, to whom I had sent her for X-ray prophylactic treatment:

"My dear Dr. McArthur: After nearly 3 years of intermittent X-ray treatment of your patient, Mrs. D., I can see no evidence of any recurrence and have discharged her as cured. Before returning to her home in Texas, I send her to you for confirmation." When this patient returned home after this simple removal of the node in her left breast, her family physician upbraided her for consenting to such an unsurgical procedure, and intimated that her surgeon should have known better; that she would surely regret it; that the procedure was little short of criminal. Three years of watchful waiting and careful X-ray therapy have spared the patient an extensive and mutilating operation—and the surgeon a potential lawsuit. The growth was removed under local anæsthesia and the patient spared the expense of hospital stay.

In 40 years of active hospital practice, I can count less than 20 cases that have seemed to me to justify such violation of all surgical teachings; therefore, be it understood I am not advocating indiscriminate departure from accepted teachings. Of these twenty, I have used a few private patients for illustrations. While fully realizing the responsibility of the surgeon when so deviating from accepted surgical axioms, and still more fully the gravity implied in daring to recommend, in occasional rare instances, operative procedures absolutely at variance with surgical teachings. I still want the honest support and endorsement of my surgical colleagues; otherwise. surgical judgment is banished and surgery becomes a set of formulæ, the surgeon disappears and there remains only the operator.

# REPORT OF CASES TREATED WITH RADIUM IN THE GYNECOLOGICAL SERVICE AT ST. LUKE'S HOSPITAL[1]

By HAROLD O. JONES, M.D., Chicago

THIS report covers a study of over 500 patients treated with radium by Dr. Watkins, Dr. Curtis, and myself.

## 1. FIBROIDS—120 CASES

Because the dividing line between these cases and those considered in the hæmorrhage group is not always definite—the principal symptom in each being bleeding—only patients with definitely palpable uterine fibroids are here considered.

The successful treatment of fibroids with radium hinges upon the careful selection of cases. Tumors larger than the size of a three months' pregnancy are better treated by surgical removal, either supravaginal hysterectomy or myomectomy; pedunculated fibroids, as well as the smaller intramural ones which are complicated by adhesions or tubal disease, are removed surgically.

The age of the patient must be kept constantly in mind in deciding for or against radium treatment, as it is necessary to bring on a permanent menopause if the symptoms are to be relieved and the fibroid controlled. Realizing this fact, only patients approximately 40 years of age or more have been treated with radium, as we believe that surgical removal renders better service to younger patients.

Now that we have radium, myomectomy may be done more often, thus preserving the uterus for possible future pregnancies. Should other fibroids or bleeding develop subsequently, these may be controlled with radium.

The technique followed is surgical aseptic preparation with careful iodinization of the vagina and cervical canal; dilatation of the cervix; diagnostic curettage with careful microscopic study of the scrapings; insertion of the radium capsule well up into the uterine cavity; packing the vagina with rubber dam or glove to hold the rectum and bladder away from the uterus.

The dosage has varied from 1,000 to 1,800 millicurie hours. Recently we have been using a smaller dose in some cases with ½ millimeter gold screen, but the majority of these cases have been treated with the larger dose, with the radium screened with two capsules each ½ millimeter in thickness.

The postoperative course of patients treated with radium in this manner is about the same as that following any curettage, except that the serous discharge is usually more profuse and persists for a longer period of time. The menstrual reaction after radium varies with individuals; some do not have any periods after treatment, while others have as many as three, usually decreasing in amount. The menopause precipitated is more acute than the normal one, but seems to yield rather readily to corpus luteum or ovarian residue. Very little change in the size of the uterus can be detected before the end of the twelfth week, after which the contraction is rather rapid.

It has been necessary to repeat the radium in 7 cases, after second treatment cure has been obtained for a period from 6 months to 1 year. Of all cases treated we now know that 69.1 per cent have been entirely relieved of symptoms for over 2 years. Not enough time has elapsed since the treatment of 22.1 per cent of cases to classify them otherwise than as improved. From 8.8 per cent no recent report has been received.

## 2. HÆMORRHAGE—129 CASES

In no other division of radium treatment is it so necessary to take into consideration so many different factors in the regulation of the dosage as in the patients still in the active child-bearing age who are suffering from so-called idiopathic hæmorrhage. Radium insertion should not be resorted to in these cases until organotherapy has been given a thorough trial.

The dose that in one patient produces only a reduction of the periods to normal or a temporary amenorrhœa, might possibly produce a permanent menopause in a patient with less radium tolerance; while on the other

[1]Read before the joint session of the Chicago Medical and Chicago Gynecological Societies, April 13, 1921. (For discussion see p. 439.)

hand a very small dose may only increase the flow, meaning in the one an insufficient radiation but in the other a prodrome of the menopause. Careful observation of the blood pressure and tabulation of the nervous symptoms are valuable aids in the diagnosis of the approaching menopause. From 750 to 1,000 millicurie hours is the maximum dose for the average individual. However, it is considered better to give initial doses of about 250 millicurie hours and repeat after three or more months if necessary, rather than to produce a period of amenorrhœa.

In the bleeding of the menopause radium is practically specific, one treatment of 1000 millicurie hours with 2 millimeter gold screen or about 600 millicurie hours with single screen, being sufficient in most cases to bring on the permanent menopause. The symptoms are here also somewhat more acute but fairly easily controlled. The first menstrual period is often profuse, the second less, and rarely does the third amount to more than a spotting.

Eighty-one per cent of cases have remained relieved of symptoms over 2 years; 16 per cent have been relieved of their symptoms but not sufficient time has elapsed to be sure of cure. From 3 per cent no recent report has been received.

### 3. CARCINOMA—100 CASES

The sensation of depression that comes to one in the study of any type of malignancy, comes more poignantly in the tabulation of the results obtained in any form of treatment of carcinoma of the uterus.

Whether one is justified in establishing any definite time limit for recurrence as an indication of cure of cancer is doubtful. This is well illustrated in a case of Dr. Watkins.

> He operated upon this patient for carcinoma of the uterus 9 years ago and she remained free from recurrence for 7 years when a nodule was found in the vault of the vagina. This was treated with radium and cleared up. A year later she began again to bleed and was given another treatment with radium and has remained well at last report.

The question of operation versus radium is one more extensive than we have time to discuss, other than to say that the pendulum of opinion seems to be swinging toward the use of radium in more cases and operation in fewer. Even those who advocate most vehemently the operative treatment, advise the use of radium either before or after operation.

The technique varies but little from that described before except that the radium inserted into the uterus is doubly screened for distant radiation of the tissues of the broad ligaments. Also needles containing radium are inserted directly into the tumor tissue using the tissue to screen the adjacent structures. In the same way radium emanations may be buried in the malignant growth and left until their full value is used. Additional capsules of radium are placed against the cervix held in place by rubber dam which also holds away the rectum and bladder.

The dosage for carcinoma is about 3,500 millicurie hours for the initial treatment with a reduction in the amount for the following doses. The number of treatments vary with conditions found after about 8 to 12 weeks as well as the tolerance of the patient to radium and complications which may have arisen.

The palliative results obtained in the treatment of malignancy with radium are just as satisfactory as the general considerations are depressing. The foul discharge is controlled, the bleeding arrested, and the pain alleviated unless there are very extensive metastases in the lymph glands when it may be augmented.

Infiltration of the rectovaginal septum and base of the bladder in cases to receive radium for palliation must be very carefully treated and the radium well screened or sequelæ in the form of fistulæ will complicate a terminal disease with more suffering than palliation.

The consideration of the treatment of carcinoma would be incomplete without urging the use of the X-ray. Exposures of 30 to 50 minutes to heavily screened rays with a voltage of 140,000 volts over the entire area are beneficial.

There were 35 per cent of the cases of carcinoma of the uterus diagnosed inoperable in which radium was used as a palliative agent, and in all it was of benefit.

In 45 per cent radium was used combined with operation either given before operation,

following it, or both before and after operation. In addition most of the cases have had series of X-rays.

In the earlier cases before sufficient radium was available some cases were operated upon which now would be treated entirely with radium. In many of these also insufficient radiation was done, both factors influencing the outcome and percentage of cures.

Many of the cases treated over the 5 year limit have been those sent from out of the city and letters have failed to reach any one who could give us the details of her progress after our last report. Five cases have remained free from definite recurrence for a period from 1½ to 2 years; one case for over 3 years. The remainder have not been treated long enough to render any other report than that recovery is doubtful.

Seven patients had malignancy in the cervical stump after previous pelvic operations.

### 4. LEUCORRHŒA—60 CASES

Dr. Curtis has been especially interested in the intensive study of chronic leucorrhœa. A brief summary of this work and its continuation is given below.

The technique varies slightly from that described before. At the time of cervical dilatation careful observation of the presence of cervical strictures and granulations is made. Two 25 milligram radium capsules, ½ millimeter gold screen, and covered with rubber tissue are sutured in the cervix for about 6 hours.

At the time of operation infected Skene's ducts are slit open and fulgurated; infected peri-urethral glands are destroyed as are the Bartholin ducts if they harbor infection.

Thirty-six of the cases are now cured; 11 are improving; 10, not having been treated sufficiently and not enough time elapsing, are classified as doubtful; 3 cases have not only been cured of their discharge but have since become pregnant. Four patients have at present symptoms of an approaching menopause.

The results as a whole have been very satisfactory and undoubtedly continued study of cases and compilation of results will prove that in chronic leucorrhœa radium is one of the most valuable therapeutic agents.

### 5. MISCELLANEOUS—100 CASES

These cases run the pathological gamut from superficial skin lesions to inoperable carcinoma of the bowel, including various benign and malignant tumors not within the scope of this report. Two of these, however, present such interesting features that their brief consideration seems pardonable.

CASE 1. A patient, age 74, came in with symptoms of obstruction of the bowel and a mass was found in the sigmoid about the size of one's fist, profusely infiltrating the adjacent tissues. A diagnosis of carcinoma of the sigmoid was made and at operation the tumor had so infiltrated the adjoining structures that its removal was impossible. A colostomy was done and radium treatment begun. Rather large doses of radium were given at intervals over a period of 9 months. Gradual gain in general health was noted with a constant decrease in the size of the tumor mass. At the last examination the wall of the bowel was smooth and its lumen was about the size of the index finger. No irregular or malignant spots could be palpated.

CASE 2. Patient, age 29, had a moderate perineal laceration with slight cystocele and some prolapse of the uterus but no other pathology. Nine months later she returned with a large sarcoma of the left pelvic bones. The greater portion of the ascending ramus of the pubic bone was destroyed and a masse the size of a grape fruit projected into the abdomen. Realizing the seeming hopelessness of the outlook the patient was informed of her condition, and abdominal section for the purpose of burying radium in the tumor was advised. This was done and 150 milligrams of radium inserted directly into the tumor in different places for 70 hours, a dose of 10,000 millicurie hours.

A portion of this growth projected into the vagina forming a mass about the size of a lemon. A week after the first application 150 milligrams of singly screened radium was placed against this mass for 24 hours. The entire skin area over the tumor region was marked off into spaces and radium was applied at a distance of about 2 inches heavily screened. during all the time the patient was in the hospital when the radium was idle. This made a total dose of about 70,000 millicurie hours.

The wound healed nicely, the patient's general health gradually improved, pain and was much less.

Four months later X-ray pictures showed metastages in both lungs and patient was advised to have series of X-ray treatments of both the lungs and the area over the tumor. This was done and has been repeated several times to date.

When last seen a few weeks ago the tumor in the region of the left pelvic bones was just a little nob

not larger than a walnut. The mass in the vagina had disappeared and in its place was a fistula-like tract, about the size of the index finger, leading up in the direction of the old tumor area. The general health has been improving and she is free from pain.

SUMMARY

1. In selected cases of uterine fibroids in women near the menopause radium controls the bleeding and causes contraction of the tumor in about 90 per cent of cases.

2. Radium is practically specific in the bleeding of the menopause; idiopathic uterine hæmorrhage is controlled in a majority of cases.

3. In carcinoma radium is a palliative agent of the greatest merit; as a curative agent it ranks at least the equal of other methods of treatment.

4. Chronic leucorrhœa yields satisfactorily to radium treatment.

## ŒSOPHAGEAL STRICTURE FOLLOWING THE VOMITING OF PREGNANCY

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IN reviewing the literature of benign strictures of the œsophagus I have been unable to find any reference to a type of stricture that occurs during pregnancy, usually the result of pernicious vomiting. Six such cases have been observed in the Mayo Clinic since 1911, and since the condition is apparently quite unusual a full report of these cases seems justifiable. Probably such strictures occur occasionally, but the association with the vomiting of pregnancy has not been considered.

Many cases of spontaneous rupture of the œsophagus following prolonged periods of vomiting have been reported and it is quite probable that the strictures in our cases were caused by the same factors. Whether or not œsophagomalacia described by Zenker and von Ziemsen, in 1878, is responsible for the condition is, of course, debatable. All of their cases occurred in males, who had induced vomiting over long periods of time. No reference was made to a similar condition in females.

REPORT OF CASES

Case 55895. Mrs. J. B., age 40, was examined July 12, 1911. The patient had five children living and well. In all her pregnancies she had had heartburn with belching of gas. Her last pregnancy began in May, 1910, and December 9, 1910, she began to vomit. Within a day or two substernal pain developed. Deglutition seemed to be free, but everything was vomited for a week, the pain becoming so severe that morphine was necessary to control it. However, the act of swallowing did not increase the pain. During the following week she managed to keep milk down and had but little pain. December 24 beef tea was taken and this brought on pain and vomiting. December 25 she aborted. For the next week the swallowing of solid food brought on the substernal pain with dysphagia; the food seemed to stick in the lower œsophagus. Within a few days the œsophagus closed completely with cessation of pain. Soon after the closure she spat up some purulent material. A physician was called and he tried to pass a stomach tube but met obstruction, and the patient expectorated pus and blood. The physician believed that a lung abscess had ruptured into the œsophagus.

A gastrostomy was performed February 4, 1911, following which the patient was able to take food. The stricture remained patent for a week and then closed so that nothing was taken by mouth. Repeated efforts to have the patient swallow a thread failed.

At the clinic the patient was œsophagoscoped and the stricture located 11 inches from the incisor teeth. After dilatation a thread was swallowed and in 2 months the stricture had been dilated to 32 F. The patient was allowed to return home. Dilating olives are passed at long intervals and the patient rarely experiences any dysphagia.

Case 86731. Mrs. H. W. R., age 33, came to the clinic June 26, 1913, She had had two pregnancies; both children were living; one was 10 years and one 3 months of age. One miscarriage had occurred one year before examination. The patient had expected to be in labor the middle of April, 1913. The latter part of March, she began to have sour stomach, but no more than with her former pregnancies. April 4 she ate a heavy meal. That night she began to hiccough and had severe pain in the stomach. This continued for 3 days, after which she vomited. The vomitus consisted of food eaten April 4.

Hiccoughs continued a few days longer and then vomiting of dark, sour material with "coffee grounds." This lasted until labor was induced April 11. The stomach was washed for a few days, which stopped bleeding and relieved the pain which had been constant since April 4, and then vomiting occurred only when food was taken. April 18 the patient suddenly fainted and passed tarry stools. A diagnosis of hæmorrhage was made. The patient began to gain and was able to eat soft foods. May 1 dysphagia began with pain at the cardia and became so marked in a few days that for 6 weeks before the patient came to the clinic only very little liquid entered the stomach and she became very weak.

July 1, 1913, gastrostomy was performed and later the stricture was gradually dilated. A specimen removed from the lesion proved to be granulation tissue. The patient was dismissed in August, 1913, able to eat anything. She developed typical pellagra after going home, but she recovered after a time and in a recent letter states that she is in very good condition.

Case 163060. Mrs. A. M. B., age 30, was examined June 16, 1916. At the time of pregnancy 13 months before, she had been nauseated and had vomited during the first 3 months, and again in the seventh month, when she vomited dark, bloody material for a week; the vomiting was accompanied by epigastric pain. Uræmia set in and labor was induced. For the past 10 months (3 months after labor) she had complained of intermittent difficulty in swallowing but without enough obstruction to interfere with nutrition. At the onset dysphagia was more marked with the swallowing of fluids than of solids.

Roentgenograms showed what appeared to be a transitory spasm at the juncture of the middle and lower third of the œsophagus. An obstruction was located 2 inches above the cardia and was dilated with ease to 35 F. with complete relief from dysphagia. Futher dilatations were made. The patient has not been heard from since she returned home.

Case 189530. Mrs. J. K., age 34, was examined March 28, 1917. The patient had been pregnant three times and during the last pregnancy which began in May, 1916, she was more than usually nauseated. During the last month of pregnancy she vomited large quantities of dark colored material. She had pain in the epigastrium and a slight rise in temperature. A normal child was born at term. Following the delivery the mother collapsed completely but responded to saline hypodermoclysis and in the course of a week her temperature was normal. Her mind was unbalanced for 3 or 4 days. She continued to vomit almost all food taken and lost 62 pounds in weight; the vomitus was not dark in color. For 3 weeks before examination obstruction had been almost complete. She did not have pain or dysphagia but a sense of heaviness, and distress which was relieved as soon as food was vomited.

A gastrostomy was performed March 31. The patient died April 8. Postmortem examination revealed a lesion beginning at the cardiac opening of the stomach and extending upward for 3 or 4 inches. The œsophageal lining was hyperæmic and œdematous. The walls were markedly thickened, indurated, and hyperæmic. Behind the œsophagus, between it and the aorta, at about the level of the sternal end of the third rib was a diffuse area of acute inflammation containing about 8 cubic centimeters of pus. The blood culture antemortem showed a growth of green-producing streptococcus. There was a small abscess in the left breast and an organized thrombus of the left uterine artery.

Case 215797. Mrs. P. McM., age 49, was examined December 5, 1917. She had been married 27 years; she had three living children; four children were dead, and there had been three miscarriages. During pregnancy 23 years before examination the patient had vomited frequently. Following delivery she began to have dysphagia and pain on swallowing. Food seemed to stick in the lower œsophagus. Frequent rectal feeding was resorted to, and the patient gradually seemed to get a little stronger. Pain was so severe and constant that morphine was used freely and the patient contracted the morphine habit. Finally the home physician dilated the stricture with rubber dilators with much benefit, but not complete relief.

On examination the obstruction was found to be 12 inches from the incisors; the stricture was dilated to 50 F. with ease. A recent letter states that the patient is in good condition.

Case 326626. Mrs. C. F. R., age 35, was examined July 27, 1920. She had been married 20 months and became pregnant 2 months after marriage. During the entire period of pregnancy she was severely nauseated and vomited, and finally at the end of the eighth month (September, 1919) the uterus was emptied of a dead macerated fœtus. About a month later when she began to take solid food she noticed dysphagia; this grew gradually worse. A diagnosis was made of œsophageal stricture and several unsuccessful attempts were made to pass instruments through the œsophagus. A gastrostomy was performed March 15, 1920. Following this the patient gradually lost ability to swallow food and for 3 to 4 weeks before coming to the clinic she was unable to take any nourishment by mouth.

August 3, 1920, the patient was œsophagoscoped. A small funnel shaped stricture was located and dilated to 31 F. The patient was then able to swallow easily. Further dilatations were employed, using a swallowed silk thread as a guide. The patient was dismissed August 28, 1920; she continues to do well with dilatations at home from time to time.

# COMPLEMENT FIXATION IN THE DIAGNOSIS OF GONORRHŒA IN WOMEN

## A Preliminary Report[1]

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GONOCOCCUS infection in women has been one of the most difficult diseases to treat successfully, due in part to there being no certain method of telling when the disease is present and knowing when it is cured.

The methods of diagnosis which have been available for use in the past have been: first, the history of exposure and irritating vaginal discharge with a burning and frequency of micturition; second, the examination, which generally reveals the characteristic discharge and should include smears from the urethra or cervix or both if possible.

Of these symptoms and signs, smears are the only certain means of arriving at a diagnosis; and doubt is cast upon even this method since other gram negative diplococci have been recovered from the vagina, so that it is contended a culture of the organism must first be made. This only increases the already existing difficulty.

Then again, positive smears are often difficult to obtain even after repeated efforts, when the disease exists in chronic form. In the Out Patient Clinic at the Toronto General Hospital, there have been negative reports returned for several weeks and then a positive followed by negatives again without any apparent increase in the discharge. The work of Palmer Findley (1) shows the unreliability of depending on the result of one smear. He found that 96 per cent of prostitutes gave positive smears, but sometimes 15 smears were taken from the same patient before a positive one was obtained.

One negative smear, or even several, cannot, therefore, rule out gonorrhœa. There are several patients in the Out Patient Department of the Toronto General Hospital who are being treated for gonococcus infection who have not yet had a positive smear, but who, from their history probably have the disease. These facts show how unreliable are smears for the diagnosis of gonorrhœa and yet, they have been up to date our best and surest guide.

There may still remain a few who treat gonorrhœa with douches and one of the so-called urinary antiseptics by mouth and believe the trouble will soon clear up. It will take at least 3 months, possibly 2 years of local application with daily douches before a patient can be apparently cured. An absence of purulent discharge, several consecutive negative smears, no return of discharge after provocative doses of vaccine or applications of silver nitrate or instrumentation are the means used to judge the genuineness of the cure. But even with all these safeguards, disappointing recurrences reveal the fact that the gonorrhœa still persists in a latent form, and in such cases the helplessness of the situation confronts us.

The other great handicap in the treatment of gonorrhœa has been that of knowing when the patient is truly and permanently cured. So many disappointing recurrences in women, from whom the disease has apparently been eradicated, have made some gynecologists like Gellhorn (2) wonder if the disease, once contracted, ever is cured. While such an extreme view is not generally accepted, there is no doubt that there is needed some better way than the discovery of an odd gonococcus or two deeply entrenched in one of the cervical glands, to know when the disease has been finally and entirely eliminated.

As. H. B. F. Dixon and A. H. Priestley (3) have so well pointed out, the syphilologist has a great advantage over the specialist in

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gonorrhœa. He has the Wassermann test, which is a great aid in elucidating obscure and latent cases, and in showing the effect of treatment; and also a drug which has a specific action on the spironema. In the treatment of gonorrhœa, a disease quite as serious, there has been no such aid, though there are far more cases of unsuspected gonorrhœa than of latent syphilis.

Until recently, the complement fixation test for the diagnosis of gonorrhœa has been considered unsatisfactory. The work of Mueller and Oppenheim (4), Bruck (5), Teague and Torrey (6), Torrey (7), Schwartz and McNeil (8), Harrison (9), Ower (10), all showed that the antigens used were not sufficiently sensitive to be of great value in deciding upon the existence or cure of this disease.

More recently Thompson (11) working at the Military Hospital, Rochester Row, has elaborated an antigen which in his hands has given very satisfactory results in deciding the time of cure in males.

It is this antigen, with modifications in the technique of the test, that has been used in the series here reported. The bloods to be tested were sent to the laboratory without history, for Wassermann reaction and complement fixation test for gonorrhœa, as a routine from all patients admitted to Ward F (gynecology), Toronto General Hospital, so that the interpretations of the reactions were not influenced by clinical histories. The results were checked as reports were returned.

The use of diluted serum and long fixation at ice box temperature have given much more satisfactory results than whole serum and incubation at 37 degrees. The technique used was as follows:

The antigen consists of a saline emulsion of 24-hour cultures of the gonococcus to which a few cubic centimeters of tenth normal sodium hydroxide are added to dissolve the organisms. This solution is then restored to neutrality (to litmus) by the addition of tenth normal hydrochloric acid. It is standardized to contain 1.000 million dissolved gonococci per cubic centimeter and diluted 1 in 10 for use in the test. This dilution was found to absorb only 1/8 to 1/5 unit of complement. Single antigens were prepared and twelve or fourteen were pooled for use in the test.

Complement is obtained in guinea pig serum and an anti-sheep hæmolytic system used, sheep cells in a 3 per cent suspension being fully sensitized with an appropriate amboceptor, by mixing and holding in the incubator for 1 hour.

The sera to be tested are inactivated for 20 minutes at 56° C. before dilution. A complement titration is set up daily using 0.1 cubic centimeters of complement in varying dilutions from 1:10 to 1:80; one series of tubes with 0.1 cubic centimeters antigen and one with saline. The latter serves as a control of the anticomplementary action of the antigen. Controls of the other reagents are also set up with these and given 1 hour in the ice chest and 30 minutes in the water bath at 37° C., 0.1 cubic centimeters of the sheep cell suspension is added and the rack returned to the water bath for 15 minutes. The complement unit is taken as the amount contained in the last tube showing complete hæmolysis at the end of this time.

Four tubes are used in the test. The first three contain 0.1 cubic centimeters of the serum to be tested, diluted 1:10 with saline, 0.1 cubic centimeters of diluted antigen and 2½, 3, and 3½ units of complement respectively. The fourth control which serves as a serum control contains 0.2 cubic centimeters of diluted serum and 2½ units of complement. Known positive and negative controls are set up as well and the racks are placed in the ice box over night. 0.1 cubic centimeters of sensitized sheep cell and amboceptor mixture are added to each tube in the morning, and the degree of hæmolysis read after 15 minutes in the water bath at 37° C. Inhibition of hæmolysis with 3½ units of complement is taken as a strongly positive (3+) reaction.

The maximum amount of complement to be fixed by a strongly positive serum was found to be 5 or 6 units.

The reaction appears generally in the second week after the initial symptoms and passes off within 3 or 4 weeks of cure. We hope to deal more fully with this phase later.

A patient convalescent from meningococcic meningitis gave two negative reactions with this technique and antigen.

Sera from fifteen men who were known to be free from gonorrhœa all gave negative results.

The necessity of using a polyvalent antigen is shown in the following protocol.

March 12, 1920. Serum No. 128.
Standard 12-strain antigen gave fixation of 5½ units complement.
No. 1 single strain antigen gave fixation of 3 units complement.
No. 3 single strain antigen gave fixation of 4½ units complement.
No. 5 single strain antigen gave fixation of 5½ units complement.
No. 7 single strain antigen gave fixation of 5½ units complemet.
No. 9 single strain antigen gave fixation of 1½ units complement.
No. 11 single strain antigen gave fixation of 5 units complement.

Had the single strain antigen No. 9 been used, a negative result would have been obtained instead of a strong positive.

## RESULTS

The results from 217 sera from women tested by this method are as follows:

| | |
|---|---|
| Total number of sera | 217 |
| Positive reaction | 116 |
| Negative reaction | 96 |
| Anticomplementary | 3 |
| Doubtful (i.e. weak positive) | 2 |

There were 116 positive reactions as follows:

| | |
|---|---|
| Smears, positive for gonococcus | 92 or 79.3 per cent |
| Smears, doubtful for gonococcus | 6 or 5.2 per cent |
| Smears, negative for gonococcus | 12 or 10.3 per cent |
| Smears not taken | 6 or 5.2 per cent |

Of those with doubtful gonococcus smears all had profuse vaginal discharges. Of the 12 showing negative smears, 7 had pelvic inflammatory masses and the husband of one had chronic gonorrhœa.

There were 96 negative reactions, as follows:

| | |
|---|---|
| Clinically nongonorrhœal | 81 or 84.4 per cent |
| Having had positive smears but at time of test negative (i. e. clinically cured) | 12 or 12.5 per cent |
| Smears not taken | 3 or 3.1 per cent |

These cases covered all stages of infection from fresh infections to chronic conditions of years' duration.

It is hoped shortly to publish a much more complete analysis of a much larger number of cases both male and female, in order that a more accurate evaluation of this technique may be made.

The laboratory work in this series was begun by Capt. J. A. Hunter, C.A.M.C., who had worked with Thompson at Rochester Row. Unfortunately he was moved from the city shortly after beginning the work and the writers have since carried it on. They are indebted to him, however, for many helpful suggestions regarding the preparation of the antigen.

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# DEPARTMENT OF TECHNIQUE

## A NEW AND ADVANCED SURGICAL TREATMENT FOR BREAST CANCER[1]

By J. F. PERCY, M.D., F.A.C.S., San Diego, California

WITHIN the year the statement has been published that the limit has been reached as regards improvement in surgical technique in removal of carcinoma of the breast, and that because of this nothing further can be hoped for in the way of bettering the statistics of breast operations for cancer. In this paper I want to add six new and additional factors in the technique of breast operations, that will, I am sure, improve very materially the present day statistics of this operation.

First, that only the hot knife be used in the removal of breast carcinoma, including a complete dissection of the axilla.

Second, that in the advanced type of case no attempt be made to preserve or secure skin flaps.

Third, that the skin around the denuded area (left without flaps when the breast and axillary glands are removed) be undermined from 2 to 4 inches with the hot knife.

Fourth, that in the after-treatment, besides the use of Dakin's solution, the arm on the operated side be maintained in an elevated position with the forearm resting on the top of the head, until practically the surface denuded by the hot knife is entirely covered with new skin.

Fifth, that vigorous, daily massage and forcible movement of the skin and arm adjacent to the denuded area be instituted as soon as granulations have commenced to appear.

Sixth, that the only carcinoma of the breast considered inoperable by the heat technique is the one where inaccessible metastasis has developed.

Rodman, in his book on *Cancer of the Breast*, makes the statement that if the cases are seen early the modern operation with the cold steel knife, in trained hands, should give a 50 per cent immunity from return, local or general, for a period of 5 years or over. My experience, however, based on my own work, would indicate that these statistics are possibly misleading, in that they are too favorable as to recurrences. I see a rather large number of recurring breast carcinomata which come with the hope that their second operation may be successful if done with the cautery knife.

It is not necessary to discuss the need for improving our operative results in the treatment of cancer, breast or otherwise. The efforts made by surgeons in the past to prevent local recurrences following operations for this disease, are a most fascinating chapter in the progress of the surgical art. The outstanding thing has been the constantly increasing endeavor to cut wide of the disease.

It is no part of this paper to dwell on the question of diagnosis, except to urge that an X-ray of the thorax be taken in every case. This is especially important if the breast is fixed to the chest wall. But I want to emphasize here that fixation alone is no contra-indication with reference to the possibility of obtaining a successful result by a cautery knife dissection and amputation of the breast.

If the cancer in its progress has not already upset vital physiological functions in the patient to a degree to make any treatment palpably hopeless she should be given the benefit of a cautery knife surgery, regardless of how extensive the primary mass of cancer itself has become.

The condition of the inoperable case of cancer is so desperate that its consideration from the standpoint of treatment places it outside the realm where ordinary surgical judgment can rule or guide us. It is in this class of cases that the cautery knife often gives the most beneficent results. The outstanding fact regarding cancer everywhere in the body is its vicious tendency to easy dissemination. Were it not for this supreme fact the cancer question would be robbed of its chief importance. Scalpel surgery does nothing to circumvent this easy characteristic of the disease. This applies practically as far as cold surgery is concerned to the early as well as to the late case.

[1] Read before the Western Surgical Association, Los Angeles, California, December 3 and 4, 1920.

Fig. 1. Incision is first lightly outlined on skin with cautery tip and then started by thrusting it through the elevated skin into subcutaneous fat and continued by following the outline. Always cut from within outward with the cautery knife. A less extensive excision may be considered desirable with the formation of flaps which permit of closure in early cases and where the growth is small and movable. Note relation of incision to cephalic vein.

*The unheated knife does not devitalize any of the malignancy it does not remove. The hot knife does. The cold knife does not spoil the soil for the further development of cancer. The hot knife does. The knife unfortified with heat, if it touches cancer, vaccinates it into new areas. The hot knife does not. The cold knife stimulates the growth of the unremoved cancer cells. With the hot knife this is impossible.*

The too frequent recurrence of cancer after the use of the cold knife, especailly in the field of operation, has disheartened both the public and the profession as to the ability of surgeons to do much that is worth while to circumvent it.

The actual technique of the use of the hot knife in cancer has for its main purpose the wide removal of the proximate lymphatics with their load of malignant cells, and the destruction of the distant ones by the dissemination of the heat

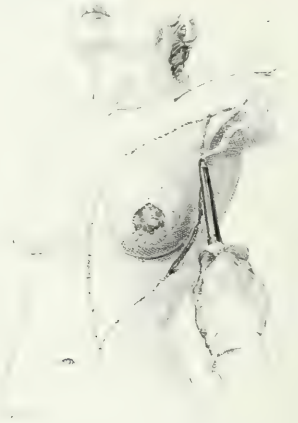

Fig. 2. Showing incision with cautery knife cutting from within outward.

as far as it is possible to make it go through the apparently uninvolved tissues. With this technique it is necessary to distinguish two degrees of development in the growth of breast cancer, i.e., the early and the late, and to apply the method suited to the individual case.

The early type of growth is characterized by the small mass which is neither adherent to the skin or thoracic wall and in which there are no definitely enlarged axillary glands.

The advanced breast carcinoma is one where the mass is large, usually breaking down and adherent to the skin, chest wall or both, and in which the axilla may show any degree of involvement from small glands to large secondary tumors. In the first or early type the operation is less radical only in that the removal of the skin with the gland is not so extensive. But, as in the advanced type of operation, the line of the skin incision is always well away from the breast, indeed, on the basis of safety we are really never justified not only in not using any of the skin over or near the tumor, but in retaining any of the skin for the purpose of flaps over the gland itself. If, however, the surgeon is willing to risk retaining some of this overlying breast tissue it should be dissected free from the gland with the knife cautery in such a way that the skin flap retains none of the gland tissue. More than this, these skin flaps should be infiltrated with the heat to a degree certain to make them also free of viable

Fig. 3. Incision of the skin completed. The cautery knife is made to loosen up and infiltrate with heat the structures between the fascia and skin from 2 to 4 inches all around the primary incision. Care should be taken to preserve the cephalic vein between the pectoralis major and deltoid muscles.

Fig. 4. Dividing the pectoralis major. Exposure of the axilla with the cautery is no different than other surgical methods in this region except that the hot knife is used throughout. It is important in dissecting the axilla to keep the fingers of the free hand near the cautery tip. In this way one lessens the danger of getting careless in overapplying the heat to the blood vessels and brachial plexus.

cancer cells. The reason for this is that the breast glandular tissue comes very close to the cutaneous structures, and when it is known that some part of its structure harbors cancer cells its limits should not be left to chance.

In the second or advanced type the line of the skin incision and excision with the hot knife extends a half inch below the cephalic vein on the upper and front part of the shoulder, inward above the axilla, continuing toward the sternum about an inch below the clavicle. From the junction of the inner third with the outer two-thirds of the clavicle the incision extends downward near the costosternal margin to within 2 or 3 inches of the umbilicus. From this point the incision is made to extend outward and upward along the costal margin to the posterior axillary line and back to the starting point. It should be stated that this incision is first outlined with the tip of the cautery knife on the iodine covered skin. After this the hot knife is thrust under the skin and is made to open this line completely from the neck to the umbilicus down to the ribs, intercostal muscles, and fascia. This at once seals the efferent lymphatics and vessels against the dissemination of the cancer cells as far as it relates to the periphery of the excised area. The dissection is then started in the axilla by exposing first the insertion of both pectoral muscles. These are severed with the cautery. From this point the technique is as if the scalpel were being used in place of the cautery knife. The branches of the axillary and subclavian vessels are cut with the hot knife and then these vessel stumps are ligated with number one plain catgut. The brachial plexus is well exposed in order to clear away the gland-bearing fascia under and behind it, and as well to get the cautery heat well up in the apex of the axilla. Thus cancer cells utterly beyond any other possible surgical treatment are destroyed, and the soil for their redevelopment taken away.

Fig. 5. Removal of the axillary gland-bearing fascia. The small vessels running into this mass are severed with the cautery knife and ligated with No. 1 catgut. After this dissection the entire breast is removed with the cautery from the chest wall by separating the pectoral muscles and skin from the ribs. Any pathologically infiltrated or adherent areas are gone over again and are thoroughly heated after the removal of the gross mass. The heating iron is also passed slowly over the intercostal muscles.

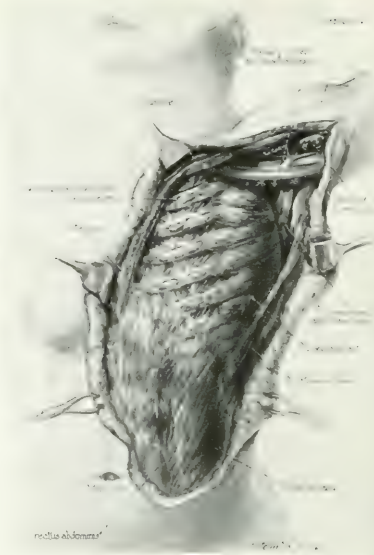

Fig. 6. The completed dissection. This is done with the cautery knife only. The edges of the wound are extensively mobilized, the brachial plexus and axillary vessels are dissected free with the hot knife leaving them absolutely clean and cancer free. The heat is thoroughly spilled into the apex of the axilla and also over the fascial coverings of the rectus muscle down to and including the umbilical region. A temperature sufficient to melt fat is usually all that is required in these regions. As a last procedure the cautery shank is slowly passed over the intercostal muscles. This accounts for some of the destruction of the rib periosteum shown in the illustration.

The dissection with the hot knife is then carried down the chest wall removing all structures to the ribs and external intercostal muscles within the space outlined by the primary cautery incisions. The external edges of this space are then undermined with the cautery for 2 or 3 inches. This has for its only purpose not the formation of flaps but the destruction of lymphatics and the annihilation of their potential load of malignant cells. This undermining is especially important toward the clavicle because the major chain of its lymphatics is connected with those from the axilla. Next, the dissection is carried across the sternum, especially at the second and sixth interspaces where the lymphatics dip into the chest. If this undermining of the skin is so complete as to involve the sternal border of the opposite breast, the practical results in the way of a lessened chance of recurrence will be increased. And then the hot knife should be very thoroughly and extensively passed downward over the fascia covering the upper part of the rectus muscle, toward the umbilicus. This is the region pointed out by Handley of England, in 1904, as one where the permeation of cancer cells is especially dangerous. He taught that a large number of malignant infections of the liver occur as the result of metastasis through this chain of lymphatics. Finally, the skin should be loosened and the fat between it and the fascial coverings of the external oblique and the latissimus dorsi, up to and involving the scapula, melted and even made to boil. This will loosen a long strip of skin posteriorly which will drop down on to the operating table be-

Fig. 7. Diagram showing approximate extent of undermining of skin for the dissemination of heat.

cause there is nothing to hold it. It is held in place at the final dressing, however, by heavy wire hooked into the edges of the skin on each side of the denuded space. Hot fat should not be permitted to run down over the normal skin, as it produces an annoying superficial burn.

I wish to emphasize here that the only instrument used in this completed operation is my electric cautery knife. An occasional hæmostat may be required. This is not used the second time until it is resterilized; neither is there gauze dissection in any part of the field. If gauze sponges are required, and this is rather rare except to mop up the melted fat, they are allowed to touch the operated surface but once, when they are discarded. The operator's rubber gloved hands are frequently dipped in a weak solution of iodine.

The two remaining steps of the technique that are new refer to the postoperative care of the patient. If the arm on the operated side is kept closely approximated to the side of the head and the forearm turned over the top of the head and fastened there, the patient will obtain the maximum of comfort. I have experimented with many different forms of apparatus and methods to maintain this position of the arm, but have found nothing so satisfactory or efficient as the simple placing of a clove hitch around the wrist

Fig. 8. The completed operation. The skin edges are hooked on to No. 14 copper wire (English standard), protected at intervals by sections of split rubber tubing. The arm is kept constantly over the head except when the wound is dressed. A rubber dam drain is placed below and at the back. The first dressing is made in 3 or 4 days and narrow rubber tissue strips are then applied across the wound at inch intervals. Dakin's or Eusol solution is applied after the first dressing until granulations appear, then dichloramine-T is substituted. The arm is maintained in the position indicated by a "clove-hitch" and fastened around the opposite shoulder by a rather ample or thick gauze bandage.

and tying the other end of the bandage about the opposite shoulder. As far as I know this position is original with this operation. It has many things to commend it.

1. It is more comfortable than when the forearm is placed upon the chest, and the arm rigidly bound to the side of the thorax.

2. Most important, it requires the natural reparative powers of the body to supply a sufficient amount of new skin to permit of the final maximum normal movements of the arm. It is comparatively easy to get the arm down after being in this position, if necessary for weeks or months; but it is almost impossible, as we all know, to get it up if the healing process has occurred while the arm is down.

Fig. 9. This patient had previously been treated with cancer paste. Metastasis into the skin and axilla were extensive. Absolute fixation of breast. Maximum abduction of arm is shown. Œdema of forearm and hand.

3. The chances for the development of a lymphangitis and œdema from cicatricial occlusion of the axillary vessels are greatly lessened. In fact, I have had no presentment of this condition in any case where this position has been strictly maintained until the wound has been completely covered with new skin.

4. The fourth requirement in the after-treatment, following the extensive removal of supposedly infected cancer-involved tissues, concerns the employment of active and vigorous movement of the edges of the wound circumference. This, however, will accomplish nothing until the bare space has begun to fill in with the resulting hyperplastic granular mass which nature finally puts in the place of the removed structures. When this is properly manipulated, i. e., massaged, a new skin, which is a remarkably good substitute for the original, develops. This usually requires 10 days to 2 weeks before a good start is made. In the meantime the wound is kept sweet with the Carrel-Dakin or Eusol solution. When the new tissue begins to appear the adjacent skin should be pushed toward the operated space, firmly and persistently, at least once each day. Failure to do this permits of the development of pale, grayish looking, easily bleeding, unhealthy granulations that will not cover with epithelium; but active, progressive, even forcible movement of the skin, as soon as the granulations are in evidence, encourages the development of a blood supply that initiates the

Fig. 10. Same patient as in Figure 9. Arm overhead. Cautery dissection extending into opposite breast. The sternum, scapula, latissimus dorsi, upper half of external oblique, axillary vessels, and brachial plexus are all exposed. The ribs are partially denuded of periosteum. Absolute mobility of all structures forming the whole extent of the wound. This picture was taken at the time of the first dressing, 4 days after the operation. No pain or temperature at any time.

development of a new epithelial covering in a most remarkable way. Curiously enough, the development of the new skin covering is not alone from the edge of the wound, but it springs up often, after 2 or 3 weeks of this persistent manual movement of the skin edges, all over the operated field. At first it looks as if small, isolated patches of frost were appearing—with the difference that they are less white than frost. These changes, when they begin to show, expand rapidly, and within 48 or 72 hours there is no doubt as to what they are. But this epithelization never develops while the unhealthy, bleeding, secreting granulations, described above, still persist. These are always an unfailing evidence that the massage and movement of the normal skin surrounding the operated field has been insufficient to make the necessary healthy

changes required for the development of the new skin.

The phenomena here described of the development of this skin covering, following this method of management, is so remarkable as almost, if not quite, to establish a new principle in the surgical healing of large wound surfaces. The skin that results from this procedure or treatment is more normal in appearance and, therefore, much more efficient than any that can be obtained by the so-called Thiersch grafts. The latter, when planted on these large areas of denuded surface, remain firmly attached to the underlying surfaces, and as such easily and frequently break down because too fragile to serve well as a normal skin covering. At each daily dressing of the wound, the whole area is actively moved and the arm massaged from the tips of the fingers to the shoulder. There is a remarkable absence of pain or temperature following this operation, either in the region involved in the treatment by the cautery knife or when the arm is moved at the wrist, elbow, or shoulder. The administration of even a small dose of morphine is almost never required. It is true that it requires a longer time for one of these patients in the hospital than when the wound is covered by skin flaps at the primary operation. But you can always have the satisfaction of knowing that in your cautery wound you have left no active cancer cells for the production of a subsequent recurrence of the disease. More than this, if distant metastases have not already taken place, you can not fail to have a better final operative result than has so far been possible by any other method recommended for the treatment of carcinoma of the breast.

Fig. 11. Showing the movability of the new skin following an extensive cautery dissection in an advanced breast carcinoma, November, 1914. In this patient flaps were made for the upper part of the wound with the cautery and applied over the axilla. Movement of the arm was practically normal in a year following the operation.

# SECTION OF THE SENSORY ROOT OF THE FIFTH CRANIAL NERVE UNDER LOCAL ANÆSTHESIA

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THE history of the surgery of the fifth cranial nerve makes most interesting reading to the surgeon and he thrills with satisfaction as gradually but surely he follows the path beset with difficulty and danger along which have traveled his predecessors in their successful warfare against one of the most mercilessly painful and formerly incurable scourges to which human flesh is heir—true trigeminal neuralgia major—tic douloureux.

It is said that Albinus and Galen suggested nerve division for neuralgia and Mareschal, surgeon to Louis XIV, is said to have done this operation, but the facial was the nerve sectioned: it is said by Rose that the first record of its performance is by Schlichting in 1748, while removal of a portion of the ulnar nerve for neuralgia—neurectomy—was done by Abernethy in 1793.

However, it was early seen that simple division of nerve branch or resection of a portion of the same was of no lasting benefit and various plans were devised to prolong the period of cure. Klein, in 1822, is said to have crushed and cauterized the divided central end and Malgaigne split the divided ends and folded them back on themselves in a loop. All methods, however, seemed to fail to effect permanent cure and it is said that when Delpech declared in 1832 that nothing could prevent the ends from uniting, the operations for neuralgia fell into disuse.

The struggle was resumed in 1852 by Roux and Sedillot. Braun is said to have suggested that the sections were not long enough and soon Thiersch was removing by dissection and avulsion even long stems and branches.

It was early observed that the closer to the brain the nerve was severed the longer the freedom from recurrence, and Malgaigne cut the infraorbital before it entered the canal and then drew it out.

Nerve stretching had been found useful in the treatment of sciatica and was tried on the fifth by Walsham and later by Vogt and Billroth. Like almost every new method it was given a trial for neuralgia but soon thrown aside.

Even cutting and stretching of the facial was in favor for a time. At first it was done on the assumption that the seventh was the sensory nerve of the face, and it was performed even after this was known to be untrue and was advised and practiced even by John Bell. It was practiced as late as 1893 by Schulze and Berger. It is interesting to note here that there is a neuralgia of the head and face for which this has been practiced by Cushing but not for major trigeminal neuralgia.

Operations for the dread disease were not confirmed alone to the nerves of the face. Nussbaum and Trousseau are said to have advocated ligation of the common carotid and Patruban did so. The treatment never became widespread or popular, although cures were reported.

In 1858 Carnochan became convinced that Meckel's ganglion was the offender in major neuralgia particularly when that part of the face supplied by the middle division was the seat of the pain. He accordingly made war upon it and excised the nerve beyond the ganglion and removed the ganglion also—again success seemed to have been achieved. Coming down to recent years we have Sluder's description of a peculiar form of facial neuralgia which seems to be relieved and often cured by treatment directed to Meckel's ganglion.

Carnochan following the track of Roux advanced from in front through the mouth and later the face across the antrum and into the sphenopalatine fossa, Luecke from the side chiselled through zygoma, malar, maxilla, and pterygoid to reach the same objective, and Pancoast arrived at the foramen ovale by passing under the zygoma and cutting off the coronoid, while Crede and Kroenlein in addition turned the zygoma up out of the way.

Claude Bernard credits Charles Bell with having discovered the respective functions of the fifth and seventh cranial nerves and with having suggested the functions of the anterior and posterior roots of the spinal nerves. He also asserts that Majendie proved that the posterior spinal roots were purely sensory and he furthermore states, that Majendie observed the fact that section of the root of the fifth proximal to the ganglion was not followed by ocular disease as was section of branches of the fifth distal to the ganglion. Waller discovered the phenomenon of degeneration and confirmed the findings of Bernard.

In 1888, Abbe divided spinal roots for brachial neuralgia—the same was done by Bennett and Horsley a short time later.

Before this, however, the removal of the ganglion of the fifth as a cure for neuralgia had been suggested by Mears, of Philadelphia, in 1884. Horsley at work in his laboratory about this time and later was trying on the lower animals the feasibility of removal of the ganglion and of division of its sensory root, and, in 1890, William Rose, a pupil of Horsley, got an opportunity to attempt removal of the ganglion in a patient. He removed the upper jaw and drilled through the base of the skull at the foramen ovale and succeeded in removing that part of the ganglion from which spring the second and third divisions.

Horsley himself in 1891, approaching from the side, opened the skull, divided the dura, lifted up the temporal lobe, and grasping the sensory root behind the ganglion avulsed it from the pons. The patient died without regaining consciousness and, although Horsley had done the operation successfully on the lower animals, he did not seem to be favorably impressed by his result on the human.

Some time previous to this Wagner had devised the osteoplastic flap method of opening the skull, and, in 1891, Frank Hartley, of New York, approached the ganglion from the side and removed it after laying down a large osteoplastic flap and reaching the ganglion by the extradural route. His case was successful. Krause, 6 months later (and after Hartley had shown his case and described his method before the New York Surgical Society), described the very same procedure. He excised the second and third divisions from just within their foramina to just beyond the ganglion, elevating the dura to do so just as Hartley had done.

In addition to do this Krause also removed by avulsion the sensory root in one case.

Doyen finding that this method subjected the brain to too much trauma and pressure turned down the zygoma, cut the coronoid, and turned it and the temporal muscle up, then removed the lower part of the squama and the wing of the sphenoid. He then gnawed away the base until the foramen ovale was reached.

Tiffany, of Baltimore, declared against a bone flap not because of added trauma or time but because its absence left easy route of access in case of future necessity. One suggestion of his I have found of very great use in this operation, i.e., to separate the dura from the base by means of a piece of absorbent cotton grasped in a forceps.

Fig. 1. The skin of the line of the incision and beyond its end is infiltrated, the loose layer thereunder is flooded, then the temporal fascia and periosteum are injected. All of the tissues, a finger's breadth on each side of it above the zygoma for a distance of 2 inches, are similarly infiltrated.

Cushing and American surgeons now use the low opening but the base is not gnawed away.

Frazier, in 1903, at the suggestion of Spiller began to cut the sensory root in preference to removal of the ganglion. In 1900, Cushing declared against such a procedure because it was not certain from experimental research that regeneration could not occur. Frazier's cures, however, were apparently just as permanent and the differences in the operations are so striking with regard to danger and difficulty that at present root section or avulsion seems to be the favorite operation in the United States.

As Frazier himself says: "When one has reached the ganglion the difficulties of ganglionectomy are just commencing but in his operation (root section) when the ganglion is reached the operation is practically over." I agree with him after trying both.

In cases operated upon under general anæsthesia I had trouble with the bleeding and also in trying to maintain the head in proper position. Mechanical contrivances once getting out of place were very hard to readjust without danger of contamination and, furthermore, the danger

Fig. 2. The fibers of the temporal muscle are separated. If retraction is very difficult the tendon may be cut along the dotted line shown. The muscle will not likely be of much value to the individual once this operation has been performed as most likely the motor root is destroyed along with the sensory.

Fig. 3. The bone is drilled with a burr and the opening enlarged downward to the base and a little farther. The opening is not quite so large as a half dollar, somewhat horseshoe shaped, convex up.

of movement was not always obviated even with a very expert anæsthetist.

It is my custom to use local anæsthesia wherever possible, and almost all operations about the head and face are done under it as a routine procedure. Therefore, last summer, I decided to try it in operating for neuralgia after having noted the ease with which Adson reached the ganglion through what amounts to a linear incision.

Abbe, in 1900, in approaching the foramina ovale et rotundum for neurectomy by Salzer's method advocated splitting the temporal muscle instead of dividing it. If the fibers of the muscle can be separated widely enough to give access a similar incision in the skin can be stretched wide enough. I saw Adson, of Rochester, Minnesota, approach the ganglion through practically an oblique linear incision, a very slight horizontal cut only being made at its lower end. If such an oblique linear incision be extended downward through the skin to a point one-half inch below the zygoma and the temporal fascia freed from its attachment to the zygoma, it is all sufficient.

All of the line of incision and beyond its end must be infiltrated, then the loose layer thereunder is flooded; next the temporal fascia (this is very sensitive like the deep fascia elsewhere) must be similarly treated, and not only in the line of incision but a finger's breadth on each side of it above the zygoma for a distance of 2 inches.

Then the temporal muscle and periosteum are similarly injected. The solution used is procaine one-half per cent with 6 or 7 drops of epinephrin to each ounce. The incision is made through the scalp and the vessels caught and tied. The flaps are dissected back, the underlying fascia is divided in the line of the skin incision and also separated from its attachment to the upper border of the zygoma. The muscle is split and the skull exposed. The periosteum is scraped off from the lower part of the squama and wing of sphenoid to the base, all vessels are caught and tied and good retraction exposure made.

The bone is drilled with a burr and the opening enlarged downward to the base and a little farther. The opening need not be quite so large as a half dollar and is somewhat horseshoe shaped, convex up.

Fig. 4. Shows relation of middle meningeal and third division. The outline of the ganglion in its dural sheath is seen.

Fig. 5. The dural sheath covering the ganglion on its superior, external surface has been divided and separated from the ganglion.

The dura is slightly sensitive but if the pledgets used in separating it are soaked in the procaine solution the process is painless and less bloody. One proceeds very slowly and carefully and soon the middle meningeal is found coming up through its foramen. Just before reaching it I encountered once the elevated ridge referred to long ago by Cushing, which had to be chiselled off. The tying of vessels generally causes some pain and I, therefore, make sure of good anæsthesia around the artery by injecting again into the tissue close to it before I begin to expose it. The vessel is tied with fine strong silk—black preferred—and the vessel is cut as it enters the dura. I have never used two ligatures.

The third division of the fifth nerve is now seen but it is generally seen while trying to get the artery ready for tying. Here, again, is a sensitive spot and it is now well to inject a few drops more of the solution around and into the sheath of the nerve. A little more elevation of the dura in front of it and one sees the second division. The dura is now elevated a little behind the third division and soon one finds the notch in the upper border of the petrous bone over which comes the sensory root into the cave of Meckel. The root, of course, is not visible as here it is inside the dura. The sheath of dura covering the ganglion is now cut at a point midway between the second and third divisions, and a small curved blunt seeker like that devised by Staacke for mastoid work is introduced and worked between the ganglion and its sheath toward the apex of the petrous bone until it goes through the foramen in the dura through which the root leaves the posterior fossa.

This is the most delicate part of the operation. If it is painful more procaine is injected into the sheath of the ganglion, but usually enough will have been injected into the sheath of the third division to have caused anæsthesia of the entire ganglion sheath.

It is well to incise the dura over the seeker a little at a time as this makes it easier to advance the line of separation of sheath from ganglion. When the end of the seeker enters the foramen in the dura through which the root enters the cave of Meckel there is pain and on withdrawing it spinal fluid flows.

When the dura has been incised along this track it is separated from the upper outer surface of the ganglion until the foramen in the dura leading to the posterior fossa is reached and the root can be seen coming through.

The inner aspect of the dura is very sensitive and a pledget of cotton soaked in a solution of cocaine, 2 per cent, is laid over the root for a minute.

Fig. 6. A small blunt curved probe is made to pass around the root and the root is cut or avulsed as pleases the operator.

A small curved blunt probe is now made to pass around the root and the root may be avulsed or cut as the operator pleases. I believe avulsion is easier and just as certain and safe.

The advantages of local anæsthesia over general have been so often rehearsed that to repeat them is tiresome. Of course, some persons will insist on being "put sound asleep before any cut is made" and others who are "too nervous" for local anæsthesia for even trivial operations.

This operation is best done with the patient sitting up—I use an ordinary dental chair which can be raised or lowered or put in horizontal position if need be. If a patient is under a general anæsthetic this is a hard position to maintain.

I know that many surgeons are opposed to local anæsthesia because of inability to secure anæsthesia. I know that it is more difficult to produce analgesia with a local than with a general anæsthetic. I know, too, that in the eyes of the patient the operation seems less serious if performed under local anæsthesia and perhaps the patient, too, may think that the surgeon is more skillful if he insist on a general anæsthetic.

I have been accused of making this a minor operation—I know that ganglionectomy is one of the most serious operations that a man can be called upon to do. No less a surgeon than W. W. Keen has owned that it was an operation which he approached without enthusiasm. I can say the same of it under general anæsthesia; I have never done ganglionectomy under local. But I have done root resection under both and there is no operation that I have ever done in which I have been better pleased by changing from the use of general to that of local anæsthesia.

The surgeon who uses local anæsthesia only occasionally should no more try to do this operation under local anæsthesia than the surgeon who operates only occasionally should attempt to do, say, ganglionectomy.

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# FINAL REPORT ON A CASE OF RADICAL OPERATION FOR CURE OF DOUBLE OBTURATOR HERNIA; FAILURE[1]

By C. VAN ZWALENBURG, M.D., F.A.C.S., Riverside, California

EIGHT years ago yesterday, December 5, 1912, I reported, at a meeting of this Society, having operated upon an old lady for radical operation for cure of obturator hernia on both sides, on March 14, 1911. This paper was published in Surgery, Gynecology and Obstetrics, April, 1913.

To sum up briefly:

This patient was a woman of 76, very much emaciated, with a history of recurring attacks of abdominal pain going back for 26 years. A diagnosis of double obturator hernia was made and an operation of radical cure performed. The abdomen was opened; a pair of forceps was introduced into each sac; the sac was inverted and stitched over and over with chromic catgut suture. The whole was quilted down upon the obturator foramen imitating a method used by C. H. Mayo in femoral hernia.

The old lady made an uneventful recovery and was thoroughly relieved from colic-like pain for 6 or 7 years.

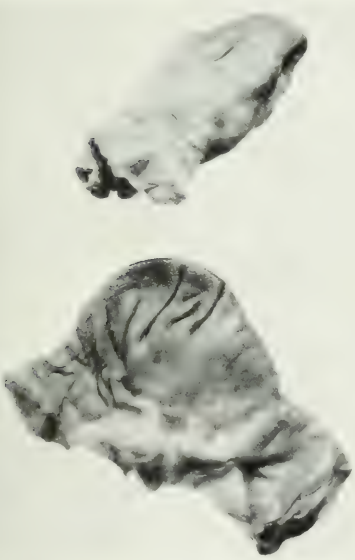

Fig. 1 (above). Hernial sac in obturator hernia.
Fig. 2. Incarcerated ileum.

At the end of this time some of the former pain gradually recurred; although of a much less severe or continuing character. Her emaciation continued and if anything increased, although she was otherwise in very comfortable health.

During last August, 1920, she was vacationing at the beach and was taken with pain about the 17th, which continued with varying intensity without the usual complete remission which had obtained on previous occasions. On August 27, she was put in an ambulance and brought to Riverside, a distance of 60 miles. She was not seen by a physician during all these 10 days. When I saw her that evening soon after her arrival, she was vomiting frequently, in fact was losing more fluid by emesis than she could take in. She suffered the usual thirst present under such conditions. Her abdomen was considerably distended, but was only moderately tender and practically confined to the right lower quadrant. Through the vagina I could make out a fold of tissue leading to the obturator foramen but I could not dislodge it. I presumed this was the intestine entering this hernial sac. This assumption later proved to have been correct.

I made the diagnosis of strangulated obturator hernia. On account of her age, now 85, the 10 days which had elapsed since the incarceration began and her profound prostration, operation was only tentatively considered and forcefully rejected by the family. She died the next day and came to autopsy the day following.

At autopsy we found the abdomen fairly distended. Opening the abdomen we found the small intestine dilated and the ileum leading down to the right obturator foramen where a loop about 3 feet from the cæcum was firmly incarcerated in the hernial sac. It was impossible to draw the intestine back into the abdomen, and, not until the right sac had been dissected out and the constriction relieved, could the loop be liberated from the opening. To our surprise there was no strangulation present. The bowel was simply incarcerated, completely preventing the alimentary contents from passing this point. Complete obstruction without strangulation.

The cause of death was doubtless the toxæmia which accompanies intestinal obstruction.

The problem of how to secure an absolute cure of obturator hernia is still with us. The different methods were discussed in my previous paper. I had hoped that this simple method would prove successful as it seems to be in femoral hernia and a study of this hernial sac which I show you (Figs. 1 and 2), seems to me should have enough body and firmness to close the opening permanently, if treated in the manner described. But alas, from some lack of finesse in technique or from the application of faulty principles involved the result was a failure.

We report failures that we all may learn. Someone will present a better technique or a better way. Scientific medicine demands the facts.

[1] Read at meeting of Southern California Medical Society, December 6, 1920.

Science ceases to be science when it fails to be truthful.

As it is some years since I saw C. H. Mayo use this method in femoral hernia I asked him, a couple of weeks ago, about his experience with it. I quote from his answer: "I cannot say offhand how many cases we have had but so far as I know the operation has been uniformly successful, that is I do not know of any patient who has returned or reported trouble by correspondence."

## IMPROVED RUBBER-COVERED RECTAL TAMPON

By J. RAWSON PENNINGTON, M.D., F.A.C.S., Chicago

THIS tampon, as described in the *Journal of American Medical Association* in May, 1898, necessitated a special covering. With increased experience I have had occasion to modify it somewhat and eliminate this covering. The tampon as now made is much cheaper and is constructed as follows:

A strip of gauze 4½ inches wide is wrapped around a piece of white rubber tubing ½ inch in diameter and 5 inches long until of desired size, (about ¾ inch in diameter). Around this is wrapped a piece of rubber dam 5 inches by 5 inches and secured with ligature at each end, *A*. Another piece of rubber dam 5 inches by 5 inches with a small hole in the center, *B*, is pulled over this rubber-covered tube and anchored about 1 inch from the end, letting the free border fall over the long end of the tube, *C*. Then another roll of gauze is wrapped around *A* as shown in *D* so as to include the anchored end of *B*, making a bulbous enlargement near this end of the tube. Next, the free border of the dam *B*, is reversed firmly pulling it over the roll of gauze to make the bulbous enlargement and secure with a ligature, as shown in *E*. *F* is a section of the complete tampon.

These can be prepared in quantity and sterilized in an autoclave, as they are now prepared and sterilized at United States Public Health Service Hospital No. 30, Chicago; or the material may be sterilized and prepared at time of operation.

Rubber dam can be purchased in sheet form from any rubber house or in rolls 5 inches wide at any dental supply house.

The tampon is introduced into the rectum through a bivalve speculum after a hæmorrhoidal operation, and maintained in position for 18 to 24 hours by a snugly-fitting T-bandage.

# A KNIFE FOR THE CERVICAL CÆSAREAN SECTION

By JOSEPH B. DE LEE, M.D., F.A.C.S., Chicago

ALL operators doing the low or cervical cæsarean section have been occasionally incommoded while incising the uterus, by the blood or the liquor amnii which pours over the wound, and which may necessitate the completion of the incision under the guidance of the sense of touch. To avoid this disadvantage and also to avoid injuring the child, the writer invented the knife shown in Figure 1. Its use is very simple and very satisfactory.

Fig. 1. Author's cervical cæsarean section knife.

After the peritoneum and bladder have been reflected and the lower uterine segment laid bare, as usual, the upper and lower delimitations of the intended opening are marked and steadied by vulsellum or Allis forceps and a small incision into the uterine cavity is made with semi-sharp pointed scissors. This tiny opening is made at the intended upper limit of the incision. The hooked knife is then passed into the uterus down to the intended lower limit of the lower uterine opening. The knobbed point is turned upward and it is easily brought through the uterine wall. Then by slow upward drawing movements, the uterus is neatly and bloodlessly slit open.

The knife could also be used in the classic cæsarean section and also with increasing experience it can be inserted into the uterus without the preliminary incision with scissors.

The knife is 22 centimeters long, of which 9½ centimeters belong to the handle. The sickle portion is 17 millimeters long.

Another improvement of the cervical cæsarean, is the separate incision of the fascia over the uterus and between it and the bladder, and its suture as an individual layer. By making the cut in the fascia a little to one side of the intended cervical incision the sutured structures are not in the same line. Experience has not shown that it is needful to adopt these precautions, which complicate the operation somewhat. Theoretically, however, they seem to insure still further against infection, and against rupture in subsequent labor, and therefore are commendable to the operator who is always striving for perfection.

# EDITORIAL


## SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. . . . . Managing Editor
ALLEN B. KANAVEL, M.D. . . . . Associate Editor

OCTOBER, 1921


## SURGICAL END-RESULTS AND HOSPITAL MORBIDITY

THE development of a good method of hospital accounting as a part of a follow-up system is necessary in order to secure comparable end-results. Good end-results are the object of operative procedures for the relief of disease. While it is desirable that patients shall not die from operation, it must not be forgotten that they were alive when they were operated on, and the fact that they survive does not of itself justify the operation. The patients must receive sufficient benefit to repay them for the loss of time, the expense, the pain, and the operative risk. Such considerations have led to the general abandonment of many operations which afforded low mortality but little relief.

In the past we have assumed that every patient who was operated upon, for example for cancer, and who could not be traced had died from the disease. Bloodgood called attention some years ago to the fact that a higher percentage of good end-results is obtained eventually in patients not easily traced than in those readily traced. This exemplifies the old adage: "Bad news travels swiftly." In our earlier experience in developing a follow-up system we were seldom able to obtain information regarding more than 60 per cent of patients over a series of years, but through the organization of an efficient statistical department with comprehensive follow-up methods we are now able to obtain information covering more than 85 per cent. If we fail to obtain information from the patient directly or from his family or friends, it is often obtained through the kindness of physicians living in the community, through postmasters, or as a last resort, through the mortuary statistician of the State Board of Health.

Another fallacy in estimating end-results has been pointed out by the actuary of a great life insurance company. The normal death rate determined by the United States Life Tables for the age period must be considered. During a period of five years at the average cancer age, fifty-two years, the normal death rate would be 9 per cent. This shows that the constant tendency is to underestimate rather than overestimate the percentage of five-year cures in diseases such as cancer.

The factor of morbidity, that is, the length of time the patient remains in the hospital after operation, is a neglected field in hospital statistics. In the last analysis the hospital must accept a business basis of comparison and strive by simplification of methods to cure the patient as rapidly and as economically as possible. This may concern the surgeon more than the hospital itself. A surgeon is often heard to say that he prefers a certain incision or a certain method of operation, as though his convenience were one of the objects of the operation. To detain a patient in

bed unnecessarily for several days after an operation, when by another method of operation he might be saved the extra expense and time in the hospital, is unjust.

Hospital morbidity, while not of the paramount importance of mortality and end-results, is of more importance than is generally conceded and merits attention. This point was brought forcefully to my mind a number of years ago by a comparison of hospital morbidity in a certain group of cases over a ten-year period. Formerly the patient was kept in the hospital for two weeks; he is now kept in the hospital one week. Today a hospital caring for 1,000 such patients in one year saves for the patients, as against ten years ago, one thousand weeks, twenty years of the lifetime of one person. Another special instance is the morbidity after operation in which drainage is instituted unnecessarily. The patient's convalescence is delayed on the average one week and the hernia liability is increased, factors contributing to poor end-results.

Several-stage operations which accomplish only what might have been accomplished in one operation, and which fictitiously appear to reduce mortality by adding to the total number of operations, are mistakes. Every day a patient is confined to bed in the hospital prolongs his convalescence after he gets about and thus adds to the economic loss.

A well-managed hospital must keep close watch of its mortality, its end-results, and its morbidity; the surgeon's work must be judged, not from one point of view, but from three points of view.

William J. Mayo.

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

Regular Meeting Held March 18, 1921, Dr. Arthur H. Curtis, Presiding

### SARCOMA OF THE UTERUS; CARCINOMA OF THE APPENDIX; ADENOMYOMA OF THE RECTO-VAGINAL SEPTUM

Dr. Mark Goldstine: The first case I wish to report is that of a woman 44 years old, who had been ill about a year when she came to see me. She gave a history of intermenstrual bleeding, with increasing menstrual flow until the last 3 months when she said that she saw "some blood" every day. On examination I found a large polyp protruding from the cervix. The vaginal end did not bleed when we cut it. The uterus was twice its normal size and felt somewhat nodular at the fundus. We twisted off the polyp which was inside the internal os, curetted the uterus, and inserted 50 milligrams of radium into the uterus and left it there for 24 hours. Patient began to convalesce nicely, then commenced bleeding. About the sixth day after removal of the polyp, we received a report on the specimen. Sections from the uterine end showed sarcomatous degeneration. Sections from the vaginal end and from the middle showed fibrous tissue. I did a panhysterectomy. The uterus, which I will pass around, is pretty well chopped up because it was so thoroughly sectioned, but we found evidences of sarcoma in the uterus. The radium had produced very little effect. The endometrium was not changed, although it was markedly atrophied. There did not seem to have been any effect produced by the radium on the interstitial tissue. The tube was healthy. The patient had a good result.

The second specimen is an appendix picked up casually, showing carcinoma. It is the fourth one I have seen. This appendix looked innocent in the abdomen.

The third case came to me primarily for upper abdominal trouble.

The woman was 37 years of age, and has one child, who is 17 years of age. Patient has been perfectly regular in her menstruation, and has had very little trouble, if any, except a slight backache. Two weeks previous to coming under my notice she observed, for the first time, a little blood in the stools. Her symptoms pointed to the upper abdomen and not to the pelvis. Vaginal examination revealed a normal cervix for a primipara. The uterus was normal in position and size. The tubes and ovaries were apparently normal. On rectal examination I felt, an inch and a half above the cervix, a nodule about the size of a hickory nut, which was not tender to touch. I made a diagnosis of adenomyoma of the rectovaginal septum. I removed the specimen 10 days ago, and sections showed typical adenomyoma. The growth was attached to the rectum, and was so adherent that it had to be cut away. It was just inside the utero-sacral ligaments three-quarters of an inch from the cervix.

#### DISCUSSION

Dr. Curtis: I would like to ask whether the carcinoma was at the distal end of the appendix where it is slashed off?

Dr. Goldstine: Yes.

Dr. Curtis: Was the appendix enlarged?

Dr. Goldstine: No.

### MISSED ABORTION

Dr. Rudolph W. Holmes: Cases of missed abortion have been considered very rare, but probably are much more frequent than the perusal of the literature would suggest. The fact of their assumed rarity is dependent upon the fact that the data concerning the phenomena of pregnancy are indefinite. A careful analysis of history is not made; therefore, the case is interpreted as an ordinary abortion. Unless the uterine contents are expelled *en masse*, there is great difficulty in verifying the facts, for it is only by such a specimen that a complete authenticated examination is possible.

Through the courtesy of Dr. Curtis, I saw the patient from whom this specimen was expelled November 23. She was 43 years of age. She had had one previous pregnancy three and a half years ago, having been married in 1903; that is, she was married 14 years before she conceived the first time, though she never had prevented conception. June 23 her last period occurred with factors present which made conception only possible between July 4 and 18. She had had no nausea, though she had more flatulence than normal during the past months. Early in September she had "spotting," then for 10 days an irregular brownish mucous discharge. In October

she had a copious bleeding, more than a period, with a recurrence of the brown discharge; November 21, 2 days before I saw her, she had a slight bloody discharge: finally, she thought she had felt life November 14. Dr. Curtis saw her in September, making a diagnosis of pregnancy of 2 months' duration, with a small fibroid of the uterus. When I saw her it was easily determined that she was not more than 10 or 12 weeks pregnant. At this time the tumor was soft, almost semi-cystic, rather movable. Dr. Curtis' findings made a diagnosis of missed abortion permissible. December 11, she had some slight bleeding with cramping for a couple of hours and expelled the mass here shown. The specimen presented shows the presence of utricular gland-crypts on the outer surface of the decidua vera. There is not complete coalescence of vera and reflexa. The amniotic sac was intact. On opening the sac no embryo was found.

DISCUSSION

Dr. Arthur H. Curtis: This patient last menstruated on June 23. She was seen by me August 24, at which time I made a diagnosis of pregnancy. There was no question whatsoever in my mind concerning pregnancy at that time. I saw her also on two subsequent occasions when I was quite positive there was pregnancy with a marked retroversion of the uterus. The period of her last menstruation being June 23 would have made the duration of the pregnancy 5 months or a little more than that.

Dr. N. Sproat Heaney: The case of carcinoma of the appendix reported by Dr. Goldstine is particularly interesting to me because during the course of a gynecological operation recently I removed an appendix, which had an inoffensive looking nodule in it which, upon examination, proved to be a carcinoma. Upon further examination I found that the growth was limited to one spot and did not pass beyond this limited area. In looking up the literature and upon making inquiries of my surgical friends, I learned that such an appendix is occasionally found and that none of the cases, so far as known, has had any subsequent difficulty. While the condition is microscopically a carcinoma, it is clinically benign in its behavior.

Dr. Holmes reports a case of missed abortion. Two days ago a patient brought into my office an ovum about the size of a quail's egg which she had aborted the day before. Upon opening the sac, viscid amniotic fluid escaped but no embryo was found. She would have been at term in about 6 weeks. I saw her soon after the beginning of pregnancy and made a diagnosis of pregnancy of 8 weeks' duration. The patient had some irregular spotting of blood and in subsequent examinations I found the uterus smaller. Since she was not suffering in any way, I advised waiting until the embryo came away of its own accord, or until symptoms arose which would indicate interference. This patient carried the embryo longer than any other case of missed abortion which I personally have had.

Dr. Charles S. Bacon: The case reported by Dr. Holmes may have been one of incomplete abortion where the fœtus came away, and the membranes and placenta were retained.

Dr. Holmes: The membranes were intact.

Dr. Bacon: The membranes may have been ruptured and closed again. When the membranes rupture and the fœtus does not come away we have an extramembranous development. Possibly in this case, either at the time the membranes ruptured or later the fœtus may have come away and the membranes closed again. In some cases during labor the membranes rupture and then another bag of waters is formed. I only suggest that might be an explanation of the absence of the fœtus in this case. At least we may ask the question: Is it proper to call an incomplete abortion, where the membranes are retained for some time, a missed abortion? Generally that term is applied to cases in which the entire egg remains in the uterus.

Dr. Charles E. Paddock: Usually the embryo is not found following a missed abortion; it is probably entirely absorbed. There must be many cases of early pregnancy where the growth is interrupted and the entire ovum digested in some way. I am sure I have more than once been right in my diagnosis of an early pregnancy and finally after a few weeks the patient returns for an examination which shows a normal unimpregnated uterus, and the reestablishment of normal menstrual function.

There are cases recorded of the placenta being left in the uterus indefinitely. Recently Dr. Hillis reported such a case. For some reason he decided not to interfere with a retained placenta; 6 weeks later an examination showed a perfectly involuted uterus. So far as known, no pieces of the placenta had come away and there was nothing unusual regarding the lochia.

Dr. N. Sproat Heaney: It might be of interest to call attention to the fact that the condition of missed abortion is not at all unknown in cows. During a study of sterility in my dairy herd, we ran across cows which carried dead ova in the uterus but acted no different than normal non-pregnant animals. In several instances, upon dilating the uterus the decomposed remnants of a fœtus would be removed. Our veterinary knows of cases where the fœtus has been retained in the uterus for 2 or 3 years.

Dr. William C. Danforth: I saw a case of missed abortion recently in a woman who had her last menstrual period in May of last year. In July her family physican found the uterus 3 fingers' breadth above the symphysis. I saw her in December and the uterus was of the same size. She aborted 1 month later with the ovum intact containing an easily recognizable cord but no fœtus. The patient was a very intelligent woman and was quite positive nothing had passed from her. It is quite probable absorption had occurred in this instance.

I had a few months ago a case of primary carcinoma of the appendix corresponding to the description already given. There is ample literature on

this subject now. It is regarded as a non-malignant condition. While histologically it is malignant, clinically it is not.

Dr. S. S. Schochet: Was any inflammatory condition in the cul-de-sac? It is known that so-called adenomyomata of the uterus, according to the work of Cullen, arise from some of the embryonic structures; and it is also possible that a so-called adenomyoma may be an inflammatory condition, that is, the peritoneum may give rise to columnar, stratified, or granular epithelium, which is very similar to the so-called adenomyoma of the horn of the uterus or tube, which was known as adenomyoma or von Recklinghausen's disease of the tube, but which is quite different from this.

Dr. Arthur H. Curtis: Along the line of the case which Dr. Holmes has described, it might be of some interest for me to tell you of a patient whom I saw recently who had gone a period of over 3 months. Examination of the uterus indicated a gestation of about 2 months. There followed an abortion of a fœtus the size of which indicated not over 2 months' gestation, and there was nothing left except the cephalic end of the embryo. This supports what Dr. Paddock has suggested, that many of these specimens are absorbed in the uterus.

Dr. Watkins and I had a patient 4 or 5 years ago who was between 5 and 6 months pregnant. Signs of pregnancy gradually disappeared and we were positive the fœtus was absorbed.

When working on rabbits, in some work I formerly reported before the society, it was easy to obtain absorption of the embryo of the rabbit when it had gone half way to maturity by the injection of placental material.

Dr. Mark T. Goldstine: In answer to Dr. Schochet's question, I will say that there was no sign of any inflammatory reaction in the pelvis; both tubes and both ovaries were normal. In incising the uterus it did not look like adenomyoma. There was no sign macroscopically of adenomyoma of the uterus. It seemed an early case of adenomyoma of the rectovaginal septum.

### LYMPHOSARCOMA OF THE APPENDIX

Dr. Eugene Cary: In regard to malignant disease of the appendix, I had a rather interesting case. Dr. Watkins saw the case with me in consultation and confirmed my diagnosis. The patient, a girl of 14, had been suffering intermittently from left-sided abdominal pain which was colic-like and associated with diarrhœa. In examining her, we found low down in the left side, back of the broad ligament, a palpable cystic mass which was diagnosed as left ovarian cystoma. Dr. Watkins reported a diagnosis of left ovarian cyst. Her condition was such that it was deemed best to operate. At the operation I discovered a straw-colored fluid and a few adhesions with the tumor in the left lower quadrant, and when it was delivered from the pelvis it was found to be an invagination of the ileum into the large intestine. There were 14 inches of invagination. We did an enterostomy, took the mass out in bulk, and found changes had taken place in this mass. Examination showed the growth to be lymphosarcoma of the appendix. At the base of the appendix there was a large firm mass which was drawn up into the intestine. She was treated with X-ray and radium, but in 3 months developed large nodules in the rectum and peritoneal cavity and died of lymphosarcoma.

Dr. Carey Culbertson: I should like to ask Dr. Holmes and those other speakers, who have reported cases of retention of gestation products for a considerable length of time, whether any of the patients showed toxæmia. Every case I have seen—and I have seen several—have shown some degree of intoxication; loss of appetite, anorexia and vomiting, albuminuria, œdema, etc.

A short time ago one of these reports came up, and I referred to a case we had at the Presbyterian Hospital years ago where the woman carried a dead fœtus 4 or 5 months. That patient died of acute nephritis.

I have seen several patients who have carried dead fœtus near term, that is, after the seventh month, but I have never seen one go more than 2 or 3 weeks under such circumstances without showing some evidences of intoxication.

Dr. Rudolph W. Holmes: If disease or accident determines the prompt evacuation of the uterus within the first 2 months, or thereabouts, of pregnancy the embryo usually will be found within the amnion. If, however, the ovum dies, and a period elapses before expulsion of the ovum the embryo may be absorbed. Breus contended that the one great characteristic between his "mole," and ordinary moles is that the embryo is always absent in his type of degeneration, while with others the embryo is usually present. Breus was not correct in making the absence of the embryo a pathognomonic criterion of the *hæmatoma subchoriale*, for we now know many circumstances may determine the absorption of the embryo in other conditions. In missed abortion there may be an interval between the rupture of the membranes, the exit of the embryo (which is lost), and the expulsion of the decidual cast, or the amnion may be expelled intact with the embryo absorbed. In our case the membranes were intact, therefore the embryo was absorbed.

You all know that Dr. Curtis has determined experimentally in animals that the complete product of conception may be absorbed early in pregnancy. I can substantiate the fact in that a patient whom I could adequately control demonstrated the possibility of the absorption of the ovum and decidua. Some 7 or 8 years ago I reported a case of a young woman who gave all the usual symptoms of pregnancy—nausea, breast-changes, arrest of menstruation—with the concomitant uterine enlargement for about 3½ months; on repeated examinations it was verified that the uterus was enlarging. Following a mere "spotting" of blood her pregnancy

was arrested, nothing was expelled, yet in about a month her uterus had returned to normal size.

Dr. Culbertson states that toxæmia develops within a week or two of the death of the fœtus. I cannot substantiate that. Dr. Beck presented a case before this society of a woman who had given birth to a full-time child. Within a month or two later she returned with the complaint that she was about as large as before the baby was born. A fœtus of about 6 months' duration was clearly palpable within her abdominal cavity. An X-ray corroborated this finding. In going over her history we found that two or more years before she thought herself pregnant but nothing came of it. She was not toxic, though that fœtus had lain the many months nearly free within her abdomen.

Some years ago a friend brought to me her daughter who was pregnant. A case of some unusual obstetric anomaly was mentioned by the mother. I replied, "That reminds me of a woman I heard of who was expecting a baby but no baby materialized, though she had a large abdomen for many years when an acute crisis developed. A number of prominent men of the profession saw her but all refused to operate. Then some young man was called who determined an operation imperative, and removed a full-time fœtus (a lithopedion) from her uterus." The mother of the patient laughed and said: "That was my mother, and the man who operated became my husband." She insisted it was an uterine pregnancy, not an extra-uterine one, yet the fœtus was carried 17 years without toxæmia.

You all may recall that it was Lord Playfair who prominently brought the question of a missed abortion forward as a distinct entity. It is a long story but he made aspersions as to the morals of a young woman whose pregnant history did not jibe with the period she had been away from her husband—he paid $50,000 for the reflection on her character.

## ACUTE APPENDICITIS IN PREGNANCY

Dr. Joseph L. Baer: I have just operated upon a case of acute gangrenous appendicitis in the seventh month of pregnancy. It is the first case I have had in pregnancy so far advanced, and I should not have reported it if it were not for the fact that two members of the society, both gentlemen with very large obstetrical practices, quite recently informed me that neither of them had seen an acute appendicitis late in pregnancy throughout his practice. This patient was a IV-para who had had right-sided symptoms for 3 days. She gave a history of previous right-sided pain 4 years ago, which had no relation to a previous pregnancy. Examination revealed a 7 months' intra-uterine pregnancy, a temperature of 99.8°; white count 13,000 and 2 hours later 12,800. The urine showed a faint trace of albumin and only a few leucocytes, and the thing which made me operate, a distinct right-sided rigidity, rather high and toward the flank. I made a gridiron incision and found a mass involving the head of the cæcum. At first it felt almost carcinomatous. The mass was surrounded by the right tube, dipping down from the 7 months' pregnant fundus. After peeling off the tube I found a gangrenous appendix buried under the peritoneum at the head of the cæcum. The infiltration and bleeding were such as to make it impossible to do any more than amputate the appendix, and close with small drainage in order to check the bleeding.

After 4 days with slight reaction and under 80 grains of sodium bromide, daily, the patient began having labor pains which lasted 3 days, resulted in temperature 104° and pulse 140, without delivery. I terminated labor by dilating the cervix and extracting the child, and after two chills in 18 hours with temperature of 105.8° the picture subsided, patient made a complete recovery, and was discharged.

Dr. Rudolph W. Holmes: I believe Dr. Baer is correct in his statement that an acute suppurative appendicitis in pregnancy is rare; in fact, I believe that appendicitis is not a frequent complication of pregnancy, in spite of the reiterated statement of general surgeons that it is so frequent that it may be assumed that pregnancy is a cause of appendicitis. In 27 years of practice, almost exclusively pertaining to women and obstetrics in particular, I have seen seven or eight instances of appendicitis in my own personal private practice. Two of these had suppurative appendices, one being gangrenous. An appendix operation in the second half of pregnancy is extremely distressing for the fœtal movements arouse acute and persistent pain in the already sensitive area of the operation; further, uterine contractions accentuate this pain.

Dr. Frederick H. Falls: Apropos of Dr. Baer's case, I saw a patient about 6 months ago at the Cook County Hospital of a primipara, with a ruptured appendix and free pus in the peritoneal cavity. I made a muscle-splitting incision and put in drainage. She was about 8 months pregnant, and 2 days after the operation she went into premature labor. I delivered her with forceps, and she made an uneventful recovery.

Dr. Channing W. Barrett: A number of years ago a case of gangrenous appendix was referred to me by Dr. Wynekoop, the woman being in the last half of pregnancy. The characteristic features in this case were that the cord was in a flattened-out condition, that the appendix was pushed against the iliac fossa, and that the latter occupied a high position. The uterus furnished the inner half of the abscess-wall. The abscess from the appendix had affected the uterus for some time. Premature delivery followed with a dead child. There was considerable toxæmia from the appendicitis. I think that most appendices that give trouble during pregnancy should be considered more from a surgical, and perhaps less from an obstetrical, point of view.

Dr. Joseph L. Baer: I should like to correct a misapprehension on the part of Dr. Holmes. My patient a IV-para in the seventh month of preg-

nancy. In my experience right-sided pain in pregnancy has usually been due to pyelitis rather than to adnexal disturbance, and the appendices I have seen in pregnancy have shown up in the early months, and not in the second half of pregnancy. This case impressed me because it was so far along in her pregnancy. The characteristic finding on which I based my decision for going in was muscular rigidity of the right side, rather high, pretty well out toward the flank, and yet not at all in relation with the kidney-position.

### THE RESULTS OF ALKALINIZATION OF OPERATIVE CASES

Dr. Eugene Cary read a paper entitled: "The Results of Alkalinization of Operative Cases." (See p. 381).

### DISCUSSION

Dr. N. Sproat Heaney: In a sort of rough way we have been carrying out Dr. Cary's idea for the last 3 or 4 years in preparing our patients for operation. We give dram doses of bicarbonate of soda every 4 hours for a day or two if possible, before sending the patient to the operating room. Our patients have suffered less than before we used this treatment. It has been a question in my mind, however, whether the improvement was due to this or due to the fact that we have filled our patients up with water during this same interval and have not allowed them to have cathartics before operation.

Dr. Carey Culbertson: With respect to the anæsthesia employed in his work, I should like to ask Dr. Cary if the same anæsthetic was used in the entire series, or if a variety of anæsthetics was used.

Dr. S. S. Schochet: I have only one case to report. We tried to determine if it was possible to alkalinize the blood without reference to the urine and gastric contents, as brought out by Dr. Cary. This case was one of alkaptonuria, due to an excess apparently of uric acid and acetic acid in the blood. The ordinary findings were confirmed by Dr. Strauss and Dr. Schultz at the Michael Reese Hospital at the time. At the suggestion of Dr. Schultz, we attempted to alkalinize the blood, and then we attempted to unite some benzol-acetic acid with the alkapton group. After giving large doses of sodium bicarbonate there was no reaction as determined either from the blood-plasma or carbonic acid. The tension was high and the result was less than 310 millionths of alkalinization. From a single dose it was impossible to make the blood more acid or more alkaline. The results were published in the *Archives of Internal Medicine* in 1918.

Dr. Arthur H. Curtis: What Dr. Schochet has told us is a well known fact, and we would be interested in hearing from Dr. Williams.

Dr. J. L. Williams: It is a well known fact that the blood is alkaline and its actual H-ion concentration cannot be changed very much by the administration of sodium bicarbonate. The alkali reserve can be decreased considerably in acute infections, as shown by Dr. Hirsch, experimentally. It has been observed that in normal pregnancy there is a slight acidosis, so far as the carbon dioxide combining power of the blood is concerned.

Dr. Edward L. Cornell: I noticed Dr. Carey gave his patients food shortly after operation. In cases where there is any intestinal work done, such as removing a chronic appendix, or anything of that character, those patients fed early, whether alkalinized or not, have less gas-pains and less abdominal stress than those fed on a liquid diet for 48 or 72 hours. This is aside from the fact that alkalinization was used before or after operation. Our experience in the use of cathartics has been the same.

Dr. Cary (closing): I have very little to add except to say that I have become quite enthusiastic over alkalinization as mentioned in the paper. I began this work early in 1915 or 1916 and changed from the routine I then employed to combat any tendency toward acidosis to a simple administration of bicarbonate of soda and the giving of glucose.

When I was operated on myself, I had a straight ether anæsthesia, and was under a fairly long time. I alkalinized myself thoroughly and took large quantities of water previous to the operation, and I can certainly say that while I exhaled ether so that I nearly gagged myself, I had absolutely no gas-pains.

In answer to Dr. Culbertson, nearly all these cases, with few exceptions, were straight ether anæsthetics.

The idea of raising and lowering the alkalinity of the blood is condemned and it is said it cannot be done. We all know that if you feed a person 3 or 4 ounces or half a pound of bicarbonate of soda, and it is absorbed in the system, it has got to get out some way. If it cannot pass out with the respired air and it is not given off in the perspiration to any great extent because it is always acid, and if the urine is alkaline, the conclusion *a priori* may be drawn that it is given off through the kidneys; and you know the work of Fisher who has acidified the blood to a certain extent and absolutely suppressed kidney-function. The kidney would lie dormant for relatively long periods of time; he would then simply inject into the renal artery of that side a little bicarbonate of soda solution; he used carbonate or Fisher's solution, and in 15 minutes the kidney would begin to secrete and functionate. Perhaps the blood is not more than ten millionths of a degree more acid than before, but nevertheless the kidneys do functionate. The kidney may secrete dark urine of a high specific gravity that contains a considerable amount of albumin and casts, evidently indicating irritation of the organ. If you alkalinize these patients they do not pass any casts or albumin; and for that reason I have been alkalinizing my patients.

Dr. J. L. Williams read a paper (by invitation) on "Uric Acid in the Blood in the Toxæmias of Pregnancy."

# JOINT SESSION OF CHICAGO MEDICAL SOCIETY AND CHICAGO GYNECOLOGICAL SOCIETY, HELD APRIL 13, 1921

## PHYSICAL FACTORS UNDERLYING THE USE OF RADIUM AND RADIUM EMANATION

Dr. Gerald L. Wendt discussed the physical factors underlying the use of radium and radium emanation. An abstract of his remarks follows:

The speaker emphasized the complexity of the radiations obtained from an ordinary tube of radium, defining and describing the alpha, beta, and gamma rays. The mechanism by which these rays are emitted from radium was explained on the basis of the present theories of the structure of atoms. In this way the close analogy of $\gamma$-rays to X-rays was shown as well as the relations between intensity, potential difference, hardness, penetration, and wave length. The characteristics of the various rays were discussed briefly, and the limitations of their use in practice were specified. The chemical changes which ensue when a radium atom explodes were explained, including the forming of radium emanation. The speaker urged the many advantages of the use of the emanation in place of radium itself. Finally, emphasis was laid on the importance of careful physical control of all radiation treatments, including not only the measurement of the amount of radium available, or the amperage in the X-ray tube, but also the specific measurement of the radiation arriving at the point under treatment by means of the newer physical appliances for this purpose.

## CASES TREATED WITH RADIUM IN THE GYNECOLOGICAL SERVICE AT ST. LUKE'S HOSPITAL

Dr. H. O. Jones reported the cases treated with radium at St. Luke's Hospital, gynecological service. (See p. 409.)

### DISCUSSION

Dr. Henry Schmitz: Dr. Wendt, who presented the scientific aspect of radiation, gave us a very clear statement concerning the chemistry of radioactive elements and the various radiations given off from them. He also called attention to the similarity between the $\gamma$ rays of radium and the X-rays. The secondary rays at present call forth much study, especially among scientists and physicists who are interested in radiation. Since we are able to measure the intensity of radiations by the iontoquantimeter, it has been possible to determine the percentage of secondary radiation in the dose. Thus, we have found that the secondary radiation with certain focal distances, filters and voltages, may amount to 75 per cent of the total radiation. How important the secondary radiation for biologic reactions may be has not as yet been determined.

The paper of Dr. Jones demonstrates the therapeutic importance of the use of radiation.

With your permission I shall confine my remarks entirely to the relation of radiation to the treatment of uterine carcinoma. We have all been interested in the standardization of the radium dosage. We have found that if the intensity of the dose is 100 at a distance of 1.5 centimeters from the radium capsule, it is 5 per cent at a distance of 4.7 centimeters, and 2 per cent at a distance of 5.6 centimeters. This percentage includes the secondary radiation which forms in the tissues.

The diameter of the true pelvis is 12 centimeters in its anteroposterior and transverse directions. We see at once that by the application of radium within the cavity of the cervical canal we will never obtain a sufficient radiation to cause a degeneration of all the cancer-tissue contained within the true pelvis. By the use of radium alone it will be impossible to obtain a degeneration of all the cancer-tissue within the pelvis. This fact has led to the combined use of X-rays and radium.

By means of a measuring chamber we have ascertained that the radiations measured from centimeter to centimeter will give a graph as shown on the screen. The graph shows that about one-half of the surface-intensity of the X-ray is absorbed in the first 5 centimeters and an additional one-half within the next 5 centimeters of tissue. The distance of the cervix from the anterior body surface in a patient measuring 16 centimeters from the anterior to the posterior skin-surface is about 10 centimeters and from the posterior surface to the cervix about 5 centimeters. Therefore, if we use two fields the cervix receives through the anterior field of radiation about 30 per cent of the skin-intensity, and through the posterior field an additional 50 per cent—giving a total of 80 per cent. It has been ascertained that to obtain a degeneration of cancer-cells it is necessary to apply the same intensity to the cancer as for an erythema skin-dose which is 100. Hence, a deficiency of about 20 per cent exists, which must be made up by $\gamma$-rays of radium. These proportions become poorer and poorer as a patient's anteroposterior diameter increases, so that with an anteroposterior diameter of 22 centimeters the summation of the X-ray dose at the cervix is only about 40 to 50 per cent. A limitation to the application of radium is given by the bladder anteriorly and by the rectum posteriorly. The mucosa of each is from 2 to 3 centimeters distant from the cervical canal, the seat of the radium-tube in uterine applications. If the radium is allowed to remain for more than 30 hours injuries will be caused to the bladder and rectum, so that within 6 months following the radium application the patient usually returns with contraction of the bladder and the rectum or both.

We have grouped our cases to facilitate trea tment as follows:

Group 1. Cases clearly localized, operation.
Group 2. Borderline cases, radium and X-rays.
Group 3. Clearly inoperable cases, radium and X-rays.
Group 4. Terminal cases, palliation and symptomatic.
Group 5. Recurrent cases, if local recurrence, radium; if regional, X-rays.

Of 168 cases treated from 1914 to 1919, 32 cases are well to date.

Of 116 cases treated from 1914 to 1918, 19 cases are well to date.

Of 70 cases treated from 1914 to 1916, 4 cases are well to date.

DR. W. C. DANFORTH: In about 50 hæmorrhagic cases, excluding hæmorrhage from fibroids, we have obtained entirely satisfactory results except in three cases. Two cases had to be re-rayed and one case was operated upon because the patient refused radiation again. I thought radiation would benefit her but she would not give her consent.

The dose, in my experience, has been about 1200 milligramhours, which has been almost universally successful in controlling the bleeding. I was glad to hear Dr. Jones bring out the point that the bleeding does not stop at once. In the early days, with no experience, we were inclined to think that the results would be immediate, but they are not always. A considerable percentage of the patients have two or sometimes three periods, and occassionally the first period may be accentuated so that the patient and the doctor are both apt to be discouraged, particularly the patient.

There are one or two other things that we must remember to tell the patient—the fact that many of them suffer from a leucorrhœa of rather watery character which may go on for 4 to 6 weeks and which needs no treatment but will disappear spontaneously. This will disturb the patient but little if she is advised about it. I do not know that Dr. Jones brought out one point which is very important—he mentioned it, but I would like to emphasize it—and that is the extreme importance of ruling out any case in which there is any suspicion of infection in the appendages.

I had one interesting case which I spoke of once before to the Gynecological Society. It was a case of a woman of 22 in whom violent bleeding had occurred. She had had a curettage and a competent gynecologist saw her at that time and cautioned her not to let the bleeding go on a second time. This advice she did not heed. She had another attack of bleeding which did not cease for 30 days, when her physician asked me to see her. At this time we gave her a full dose, explaining that sterilization was better than death, and that did control the bleeding permanently, although after about 10 months she began to have a very slight menstrual period which has persisted up to the present time. I think this case could not have been handled in any other way. While patients so young should be treated very rarely there is no doubt a small number of cases in which radiation will help. Irradiation, however, in young women must be most carefully restricted.

I was also glad to hear Dr. Jones bring out the point that radiation should preferably be applied at or near the menopause. He stated that patients under forty should be radiated only under exceptional circumstances. We cannot tell the exact degree of susceptibility to radium, and where sterilization is not quite all right radiation should be used with extreme caution.

Dr. Schmitz brought out a point in regard to the very hopeless cases of carcinoma. Large, widespread growths I think are sometimes made worse by radium, because it stimulates and helps to spread the growth. In the last 2 or 3 weeks I was asked to see an extensive case of this sort, an enormous mass filling the vagina and lower segment, with fluid in the peritoneal cavity, in which it seemed to me radiation was entirely wrong and that morphine was the only agent to be considered. That is a point which I think we should keep in mind.

DR. N. SPROAT HEANEY: I was especially pleased to hear Dr. Jones emphasize so well the restrictions with which radium is to be used. First of all the most important use is in fibroids and other cases of non-malignant hæmorrhage which would be poor operative risks. Second, in such cases where it is unimportant if the function of the ovaries is destroyed. The most brilliant use of radium is in myopathic hæmorrhages which are so liable to occur at the menopause. Unless, of course, the case is a poor operative risk, I have restricted the use of radium in such cases to such as have no other genital complication such as prolapsus or retroversion or other difficulty which, when the bleeding has disappeared, may annoy the patient. I would prefer to operate, for instance, in the case of myopathic hæmorrhages and prolapsus if the case were a good operative risk. I have been very careful about the use of radium in young women. I have administered it to only one case of idiopathic hæmorrhage in a young woman. In this case I presume I did not use sufficient dosage because after an interval of amelioration, the hæmorrhages returned as bad as they were before.

As far as the treatment of leucorrhœa by radium is concerned, I am going to await further developments in Dr. Curtis' work before I take it up, except it be in the case of a patient who is of such age that child-bearing is not to be thought of or where some unexpected effect upon the ovaries would not be of importance. Since the effect of radium upon leucorrhœa must be through the destruction of the glandular elements and their replacement by connective tissue with resultant fibrosis of the cervix—since its action in the cystic cervix cannot be much different than the effect we obtain after irradiation for carcinoma, for instance—I fear to use it where pregnancy may subsequently develop since I am quite sure that the dilatation of such a cervix would proceed with great difficulty.

Though Dr. Curtis reports some cases of pregnancy after such irradiation, we cannot gauge the effect of radium and there must be certain cases where, in spite of great care, the ovarian function would be interfered with.

Dr. C. W. Hanford: I would like to say just two words of warning: first, in regard to the dosage in women under the menopause period, and second, the use of radium when there is sepsis. I have records of three cases in a series where 250 milligram hours has produced a permanent amenorrhœa, much to the disgust of two of the patients and the delight of one. Bacterial sterility must be established before radium is used. Radium is not a bactericide in any sense and if there is sepsis that must be cleared up before damage is produced by radium.

It is not supposed that radium experts look to expense at all, but in the use of a screen if you use a brass screen gold-plated it will answer the same purposes as a gold screen, and is much less expensive.

At the Memorial Hospital in New York they do not now pretend to operate on malignancy without a preirradiation, and after the operation, radium is again used. After the study of a long series they believe in its prophylactic value.

As regards the recurrence of hæmorrhage after the use of radium, I believe in about one-third of the cases bleeding occurs for two and sometimes three periods but the last does not amount to very much. I think we have all learned to tell the patients these things.

Dr. Ludvig Hektoen: That radiation in infections may have bad effects, to which Dr. Danforth and Dr. Heaney have made reference, is supported by experimental evidence. I have found and others have found that roentgen-rays in sufficiently large dosage in animals—rabbits and dogs—may inhibit the formation of antibodies, and it may well be that the evil effects of radium and roentgen-rays in cases of infection are due largely to the suppression of antibody production.

Dr. Henry J. Ullman: I would like to know whether any information has been obtained as to the shortest wave-length measured from radium C. Also, in referring to the voltage of 140,000, does it correspond to the peak voltage?

Dr. Arthur H. Curtis: I think none of us who has had experience with radium can help feeling more and more enthusiastic concerning the application of radium to cancer-patients as time goes on. When we see these women who are run down and emaciated, with a foul-smelling, bleeding mass, come back to us after they have received one or two treatments and they are feeling fine, their appetites improved and the mass healed, it is very encouraging. On the other hand, when we go over our statistics and find, as Dr. Jones and I have had the experience of doing, that we have to search very hard and gloss over thesurface so that we are not ashamed to get up and talk about radium, we have to be a little conservative. I cannot help thinking about the old doctor down in the country who said, after I had been talking about radiumtherapy: "Young man, the pendulum is going to swing back and you will find that stuff not so good after all." I can't help feeling that we will have to stick to the statement so often heard from those who have the most experience—that radium is the one palliative remedy but we have not yet found a cure-all. So far as I can see from the present outlook, radium should be used as a palliative measure. It should be used whenever we operate; should by preference be applied before operation and subsequent to operation. If we get into an operation where we thought the growth was well localized and find that we are in deep water, that there is evidently an extension of the cancerous growth beyond the confines where it can be removed, we should think of applying radium, inserting it into the tissues in the region of the ureters and the large vessels instead of trying to dig down with the knife or scissors.

One little point that has not been dwelt upon is this: a good many of the so-called "idiopathic hæmorrhages" are functional hæmorrhages, which come on in women 35 to 37 years of age. During the past 2 years I have come to believe that the signs of the menopause or change of life are not limited to women of 41 to 43, but that there is already a decadence of the organs of internal secretion at a much earlier age. If we treat a woman of 35 or 37 who begins to develop abnormal uterine bleeding at the time of the menstrual period, even though we employ a comparatively small dose of radium, such as is borne very well by the younger women, we are apt to produce a premature menopause because the woman has already the menopausal symptoms.

Dr. Gerald L. Wendt, (closing discussion): I realize, of course, that it is very much easier for a man who is working in a laboratory with the chemical and physical elements to be enthusiastic about radium-treatment than for those who are working clinically. There is no doubt that the conditions are very much more definite in the laboratory. Yet I am not so much of an optimist as to feel that it is easy to determine that any one dose will have the same effect on all patients,—we probably cannot say that an erythema skin-dose is just the same for all people, or that the same application will have the same effect on all cases. Aside from such considerations, there is every reason for optimism when experimental work is accurate. The technique of Dr. Schmitz shows what can be done in that direction. But there is a vast amount of loose work that comes to the attention of the man in the laboratory and one large cause of the pessimism is because scientific results are not obtained. I have received from a Chicago hospital a tube which was supposed to contain 36 milligrams and found that it had actually only 14 or 16 milligrams, yet that tube had been used regularly for treatment. Not only is it common to fail to realize just how much radium is present, but also to ignore conditions with regard to screening and so on.

I think if the quantity of radium present is carefully determined and its use is carefully and scientifically supervised by a competent physicist a large number of the past failures will be easily explained and remedied.

It cannot be too strongly emphasized, as was mentioned by Dr. Jones and others, that a small dose instead of being destructive is stimulating. That is not peculiar to radium but is common in many chemical reactions. A small fire if blown on gently by the breath will flare up more brightly but if blown on by a strong wind it goes out altogether. This radium treatment has led to stimulating and harmful effects when conditions have not been carefully regulated. We have so often met the disastrous results that I could not refrain from mentioning this.

Radium is not a bactericide. For some reason bacteria are very indifferent to the action of X-rays and radium rays. It would seem that growing tissue is very much more susceptible to radiation than is other tissue. Any rapidly growing cell is a favorable one for the action of radiation. Yet bacteria do not respond and sepsis cannot be prevented by radiation and therefore should be absent in all cases treated.

I neglected to say in regard to secondary rays, that it is essential where you have a radium-tube close to the organ being radiated and are using a brass or gold applicator to enclose it in a rubber tube. Otherwise, you get secondary rays which are harmful to the tissues. The coating of rubber is necessary because, while it does not give off any secondary rays, it is able to absorb the rays that come from the metallic capsule. The material of which the capsule is made is of little consequence.

It seems that the treatment by radium before and after removal of a growth is the most common and certainly the wisest procedure. Radium alone does not accomplish what surgery does, but as a prophylactic measure after operation it has high value.

Dr. H. O. Jones (closing discussion): I believe there was only one question in regard to the details and that was concerning the X-ray. I have very little personal knowledge concerning this, but the man with whom I conferred said that the voltage of 140,000 was on the peak basis, and stated that the spark gap was not of very material significance.

### TORSION OF UTERUS WITH FIBROID

Dr. Emil Ries: This specimen, black as you see it, was removed from a woman 75 years old on the 22nd of last March, after she had carried it for 40 years. Forty-nine years ago, when in labor with her first child, she was supposed to have twins. One child was born and there was a big mass remaining which was supposed to be another child but was found to be a tumor—and here is the tumor. Forty-nine years ago it was of such size that it was mistaken for a twin. The patient gave birth to three more children after this tumor was found in her. In all three labors the placenta had to be detached manually. The last child was born 37 years ago; there has been one miscarriage since. Her menstrual periods after the birth of the first child were always copious and painful. After the miscarriage the menstruation was very profuse and painful. Since her fifty-fifth year when she had her menopause, there has been no discharge from the uterus or vagina, but there have been attacks of pain which were localized in this tumor. These attacks were associated with some nausea and some constipation, but practically no vomiting and no fever. She went on like this until the 17th of last March when she was taken with a very severe attack of pain, vomited a little, the abdomen became distended, it was impossible to get the bowels to move and the tumor rapidly became larger and harder and very painful. The family physician made a very correct diagnosis of torsion of the pedicle of the tumor. The tumor was lying to one side and it was easy to assume that it was ovarian, especially as the patient stated that it had been on her right side all her life. On March 21 I saw her and advised operation.

On the 22nd she came for operation. The abdomen was opened in the mid-line and the tumor presented, and was black. We were not surprised at the black color because we had suspected a twist of the pedicle. The unusual thing was that all the appendages were hanging free on the side and the uterus itself was the pedicle, with three twists of 180 degrees. I untwisted the tumor on the table, demonstrating how far it had to be twisted back before it was all untwisted. There was a little free fluid in the abdomen and one coil of small intestine adherent to the tumor, but otherwise no adhesions. Below the twist the remnant of the suspensory ligament of the ovary was perfectly white. At the point of the twist there was as sharp a furrow in the cervix as you can see in a strangulated bowel.

The operation was very simple, only 17 minutes elapsing from the time of the incision until the last stitch was placed. The patient took about 120 cubic centimeters of ether. She left the hospital in 2 weeks. She is now perfectly comfortable and walking about.

The interesting part about the tumor is that it is infiltrated with blood. In the posterior wall you see a yellow tumor which is an old fibroid and which has undergone calcareous degeneration to such an extent that when I tried to open it I had to use a chisel. The uterine cavity is lined with black mucosa in consequence of the hæmorrhage and has no communication with the cervix. The uterine cavity was filled with blood and the cavity in the old degenerated tumor also was filled with black blood. There was no degeneration in the uterine wall; nothing but the infiltration with blood. There was no malignancy anywhere. I may add that we have found one other reason for her abdominal pain in the last 20 years. The incision went up to the umbilicus and during my examination I saw a gall-bladder the size of an orange coming down

from the liver filled with clear greenish fluid and separated entirely from the cystic duct.

### ADENOCARCINOMA OF THE UTERUS

Dr. C. Henry Davis, Milwaukee, Wisconsin: I wish to exhibit two specimens and report briefly three cases of adenocarcinoma of the uterus because of certain interesting features in the diagnosis.

Last October a patient was sent to me with a history of incontinence of urine of 9 months' duration. There were no other symptoms of any sort. The examination failed to show any physical reason for the incontinence and the examination of the urine was negative except for a slight trace of albumin and a few hyaline casts. A second specimen the following day showed a similar condition. A second pelvic examination was made and certain findings previously noted were checked up. At the time of the first examination I found a freely movable mass the size of a goose-egg in the right side of the pelvis. The uterus was small, but nodular. The woman was 58 years of age—a number of years past the menopause. She had been married for many years but had never been pregnant. My original belief was that she had an old tubo-ovarian infection and small multiple fibroids of the uterus which, as she was past the menopause, would cause no further symptoms.

In checking up the history as taken before the first examination it was noted that the trouble from incontinence of urine had gradually increased until at the time of examination a pad would be saturated in 4 or 5 hours, day or night. At the time of the second examination a speculum was inserted and the cervix was carefully inspected. In the cervical canal fluid was present. This was wiped away, but in the course of a minute another drop of fluid appeared. A dry tampon was inserted and left in place for about 5 hours. At the end of that time the pad which was given her at the office was dry, but the tampon was soaked. I made a diagnosis of probable malignancy and 2 weeks later this specimen was removed. The mass on the right side proved to be a leiomyoma of the right ovary, and the small masses on the uterus proved to be small leiomyomata. There was a small adenocarcinoma in the uterine cavity independent of the leiomyomata. The patient had a stormy convalescence because of myocardial symptoms, but is now in excellent health except for heart condition.

The second case presents another problem in diagnosis, and brings up a question as to how many years an adenocarcinoma may exist in the uterus without killing the patient.

This second specimen was removed one week ago from a patient whom I first saw in February of last year. She gave a history that in July, 1916, while having menopausal symptoms, she began to bleed and bled until the end of August. In September she had a period which was fairly normal except that it was very profuse and lasted longer than usual. In October there was a similar menstrual history. In November she was operated upon by a Chicago surgeon who removed a malignant tumor of the left ovary without, apparently, investigating the uterus. Following this operation she continued to have a vaginal discharge but did not have any more bleeding. The nervous symptoms of the menopause persisted.

Because of slight abdominal distress she came to me for examination in February, 1920. Because of a rigid hymen it was impossible to make a satisfactory examination in the office and I advised that she go to the hospital for anæsthetic examination or return to Chicago and consult the surgeon who removed the ovary. She returned to Chicago and was assured that she was all right, but very anæmic.

April 2, 1921, I removed from her cervix a polypus which was attached near the internal os. This polypus proved to be malignant. After consultation regarding the patient's fitness for a radical operation, this specimen was removed. There is a carcinomatous mass filling the entire cavity of the uterus. The uterus when opened showed that the polypus had projected from the internal os and doubtless was an extension from the growth above. The question is, did this woman have an adenocarcinoma in the uterus in 1916, or did it develop subsequently?

The third case, a woman of 62, called on her family physician in June, 1919, because of a slight bloody discharge from the vagina. He found on inspection a slight ulceration of the cervix and after a few ichthyol-glycerine tampons the bleeding stopped. In June, 1920, a slight bloody discharge developed while walking. She returned to her physician, who gave her a few tampon treatments, this time without improvement. I saw her early in July. At that time the blood-pressure was 220; there was a slight ulceration of the cervix and it seemed possible that due to the high blood-pressure, blood was oozing from a senile mucosa. She was suffering from an old mitral stenosis and myocarditis. She was a very stout woman and a satisfactory examination was out of the question without an anæsthetic. Her condition was such that we decided to put her to bed and keep her at rest. Under treatment the pressure gradually dropped to as low as 138, but the bloody discharge gradually increased. By the end of September her condition was such that we believed she could stand an anæsthetic, for diagnostic curettage. The curettage gave profuse scrapings which microscopically showed the presence of an adenocarcinoma. This was clearly a case for radium-therapy and during the next 3 weeks she received a total of 4,783 milligram hours. Her condition since then has been gradually improving and at present she is as well as at any time during the past several years.

These three cases are reported because, in my experience, the symptoms are rather unusual and they suggest that we may all overlook adenocarcinoma of the body of the uterus until it has been present for many months.

# JOINT MEETING CHICAGO MEDICAL AND CHICAGO SURGICAL SOCIETIES, APRIL 20, 1921

Dr. William Fuller, President Chicago Surgical Society, Presiding

## IS AN EXPERIENCED SURGEON EVER JUSTIFIED IN VIOLATING THE RECOGNIZED SURGICAL TECHNIQUE IN MALIGNANT GROWTHS?

Dr. L. L. McArthur read a paper entitled "Is an Experienced Surgeon Ever Justified in Violating the Recognized Surgical Technique in Malignant Growths?" (See p. 406).

### DISCUSSION

Dr. Ludvig Hektoen: I remember well the case of the tumor of the front of the mandible that Dr. McArthur referred to. It was a typical giant cell sarcoma. May I say also that Dr. McArthur's procedure in the cases he described certainly has been justified fully by the outcome in each case.

Dr. E. W. Andrews: Four of the individuals reported by Dr. McArthur in the series of twenty I have personally examined and in each case I was struck with the superiority of judgment of the thinking man over that of the routinist. The routinist would have badly mutilated all of these people and have damaged them physically to an extent that was not necessary and would have done it following out what Dr. McArthur called tonight the standard rules of surgical practice. Now I question those rules. Ought we to have them? Who made those rules and what authority do they rest upon? It brings up the broad, general subject of conflict, which I think has always existed and always will exist between inductive science, the science of observation, and deductive or the science of reasoning. That is not saying there is no room in medicine for general rules and standardized procedures. It just brings up the whole question of the infallibility of these rules and their permanence. Too many rules lead us into scientific militarism. Militarism is illustrated by what occurred during the war. There were rules sent out from the bureaus absolutely forbidding certain things and minutely ordering certain other things. But scientific truth is not a thing of ironclad rules; it is a thing demanding research and analysis. At one period every case of empyema had to be operated upon immediately when seen. The same bureaus sent out within a year orders reversing this method of treatment. We see the same practice in surgical teaching; certain recognized principles are infallibly laid down in one generation and are freely contradicted in the next. I suppose another illustration would emphasize this point. Dogmatic rules are advocated in the great national meetings of our societies, as for example, that every case of appendicitis must be operated upon the moment it is diagnosed, only to see such rules lived down in the experience of certain men whose minds could rise above mere routine. So this sort of a paper interests one who likes to take a broad view of the plain truth and nothing else. There is not in science any place for standardization which crystallizes to such an extent that broad-minded men at certain times cannot lay it aside. If there were such a place all progress would be at an end; medical science would have become a dead thing.

Dr. William Fuller. The paper to which you have just listened gave the result of personal experiences in the operability of malignant disease. Those who feel able properly to select the cases calling for limited surgery as recommended in this paper should, in the future, probably do better work in malignant disease.

A few thoughts on this subject have long been in my mind and I should like to express them here. Twenty-five years have passed since I first witnessed an operation for malignant disease. During this time I have heard many discussions, and have read valuable contributions to the literature on this subject. The research worker has provided the profession with much valuable information on cancer, and the surgeon has perfected a technique in operating which the future, immediate or remote, will hardly improve upon. It has long been my belief, more strongly now than ever before, that the qualified medical man could more often effect a cure in malignant disease than now is the rule if a few obstacles to his work could be brushed away.

It is probably true that the mortality in malignant disease is as high, if not higher, than it has ever been before. It is also true as some have stated that one woman in seven and one man in eleven the world over are dying with some form of malignant disease. People no longer believe strongly in surgery as a means of curing cancer; they have become skeptical as to the value of radium and X-ray; and as a result of this, the victims of malignant disease are finding their way in droves to the cancer quacks, and are fast falling further victims to the miserable and wretched teaching of the various cults the followers of which thrive and fatten on the credulity and ignorance of these people. To all this deplorable thing the scientific doctor without protest stands calmly by and realizes well the cause of the high death rate in cancer, and accepts with resignation the maledictions heaped upon his head for his short-comings in his efforts to cure cancer. Why not agree to these expressions so

often heard and admit that measures now employed for the cure of malignant disease fail utterly, but let us make sure to place the blame, in part at least, exactly where it belongs, namely, at the door of the cancer victim.

Is it not time if we are to go on with future efforts to cure malignant disease that some attempt in some way or somehow be made to teach people generally a few well known facts about cancer which are so essential and necessary. May we not teach that first, the cure of malignant disease calls for co-operation on the part of the able doctor and the alert and intelligent patient; that cancer as we view it today is in most instances at least a local condition in the beginning and that while it remains so it is amenable only to the ministrations of the scientific medical man; that after it is no longer local but has become metastasized, no form of treatment known today will avail anything; and that further, he who contends otherwise is ignorant of what cancer is, or an imposter, or both. Teach people that the opportunity for cure of malignant disease "knocks unbidden once at every door" and he who fails to hear or to heed is gambling with death with odds against him.

I have great faith in our ability to teach to the laity some of these vital facts. It is time now to speak out and endeavor to show further that measures for the cure of malignant disease other than the ones here mentioned are futile and are the result of muddled thinking on the part of silly and misguided people. Unless the future provides some means of disseminating a little better, or further knowledge on the subject of malignant disease among people generally, 25 years more or many times that will find the profession groping about in an aimless effort, trying to free itself from the dilemma in which it now finds itself in the rather hopeless attempt to cure malignant disease.

It seems to me that just so long as legislators and lawmakers spread upon the statute books laws which legalize the practice of medicine by men not qualified to practice it, and I refer particularly to the devotees and disciples of "new thought," Christian science, osteopathy, chiropracty, with other humbugs, just so long will we be confronted by problems which we can never solve. Prompt and efficient treatment has reduced the mortality in many surgical affections to practically nothing, among which is that of appendicitis. Will not the same timely and intelligent action on the part of the profession and the laity as well, measurably reduce the mortality in malignant disease?

The pro-cancer lesion is not receiving the attention its importance demands. Some dispute any relation between this lesion and malignancy, particularly the workers in research on cancer and the students of the pathology of this disease. "A woman with a benign tumor in her breast is just as liable to have cancer in her breast as the woman without such a tumor, but no more so" is a statement which was made from this platform recently, which is wrong and should not pass without a challenge. Cancer is prone to develop in tissues having passed their life of greatest physiological activity; more prone to develop, as we see it clinically, in such tissue the seat of any pathological condition, an observation which has thousands of times been made by surgeons the world over.

If there is no relation between this so-called pre-cancer lesion and subsequent malignancy, then why is it that an individual who has long had such a lesion will develop a cancer right directly in this lesion? Again if the pre-cancer lesion has by surgery, or other means been cured in an individual, why will his cancer develop at some point other than the one which was the seat of the pre-cancer lesion? The individual with an uncured lesion develops a cancer in his lesion; the individual with a healed lesion develops a cancer at some point other than this. Why?

I believe that any pathological condition, such as constitutes the so-called pre-cancer lesion, be it never so insignificant, occurring about middle life, and which fails to undergo spontaneous healing, or fails to respond promptly to treatment, should be regarded as potential cancer and treated accordingly. If this teaching could reach the average individual, by reducing it to terms fully understandable in all instances, we would, to begin with, see less malignancy. The ulcerating wen, the fissured lip, leucoplakia of the tongue, tumor of the breast, the gastric ulcer, the various trivial lesions frequently seen on the uterus, with the manifold lesions of the skin, like seborrhœa, keratoses, moles, warts, etc., would soon be regarded as serious matters oftentimes, and receive the prompt and energetic attention many of them demand.

Let us remember that with all our vaunted knowledge of malignant disease, people are still dying at a sickening rate everywhere. As the matter now stands has not the physician already acquired knowledge on this subject of which he is making no use? His knowledge is sound and complete enough, but has he the material at hand on which most effectively to apply it? Is this not the type of knowledge of which Froude spoke when he said "The only knowledge worth while and that has life and growth in it, is the knowledge we can use; the rest hangs like dust about the brain and dries like rain drops off the stones." In other words we, as a profession, are "all dressed up with no place to go." If the qualified physician is the only authority on cancer and allied diseases, the sooner the world finds it out the sooner will the pretender and the parasite reach his level.

You will recall that splendid meeting of the representative members of the profession which took place some 2 or 3 weeks ago here in the city. You have no doubt read and possibly heard them discuss the high aims they are planning for the uplift of medicine as they have done in previous years and you have seen many of their plans materialize no doubt. But let me call to your attention the very

small percentage of the community that will ever know that such meetings are even being held. Indeed only a small percentage of the profession, not to mention the general public, will be cognizant of what was said and done there. Would not some legitimate means of publicity have been a profitable thing; might not the public have been invited, if not urged, to attend these meetings and learn what the science of medicine is really aiming to bring about?

Now let me bring to your notice a method of advertising, a propaganda which I show you here. I hold in my hand a copy of one of our great daily papers in which the chiropractors take a whole page to tell the people of the country what marvelous things are coming to pass as a result of their teaching. Upon this page we are regaled with the fact that 9,000 chiropractors of the country are "making the blind to see, the deaf to hear, and the paralyzed to walk." Think of it! Nine thousand of these shining lights competin gwith Dr. McArthur, with you, and with me, in the treatment of the sick. This is a means of disseminating knowledge, gentlemen, to which a self-respecting individual could hardly stoop, but it, nevertheless, reaches the entire community, and everybody in it from childhood to manhood, from the ploughboy to the plutocrat, and tells them in plain but untruthful English how they are "curing" man's ills and "putting it all over" the medical man. Let me remind you again that this is not believed by the ordinary individual only, but by the university professor occasionally, the college graduate, the farmer, the business man, the banker, and the baker.

Is it not time, I would ask again, for us to divest ourselves of a little modesty, be it false or real, and frankly tell the world a little of the truth about this matter? Or shall we go right on for ages to come witnessing the continuation of the old régime for our own edification and satisfaction while the "arch enemy" of mankind is taking its toll in death of thousands of people everywhere on the face of the earth?

Surely it seems to me that any legitimate plan, scheme, or method that could be carried out and that would disseminate knowledge among the people or the public to the end that a few points or facts here mentioned might become common property or knowledge, would eventually bring about a more early and timely co-operation on the part of all concerned and result in the prevention and often the cure of a disease which has long been a nightmare to the best and brightest minds of the world.

Dr. Max Thorek: I did not intend to say anything this evening but there were so many keynotes sounded relative to the illustrious paper of Dr. McArthur that I could not resist for 5 minutes to dwell on some of the salient features. We have not been sticking closely to the issue of Dr. McArthur's paper. The principle of his argument is, are we justified in laying aside certain standard rules which we are taught in medical schools? It has been brought out in the discussion that that may be done. We may argue until doomsday as to the etiological factors of carcinoma. This is no place to argue them. We know nothing of it. We may entertain the Cohnheim theory or the theory of infection or whatever we like. It is an established fact that the etiology of carcinoma is obscure.

The second problem is: Shall we teach our students the fundamental principles and differential diagnostic points of carcinoma and other malignancies and teach them to recognize them? I believe as far as the student is concerned that it is absolutely proper to inculcate him with the fundamental principles as far as underlies the etiology and differential diagnosis of malignancy, but when we talk to medical men or to surgeons of maturer judgment the picture assumes an entirely different aspect. A valuable lesson could be learned from the case cited by Dr. McArthur in which a giant-cell sarcoma, as diagnosed by Dr. Hektoen and confirmed by another pathologist, could be removed and the patient live for so long a time without a recurrence. However, that is not true in every case, as Dr. McArthur said. He is competent to judge. A man only is competent to judge who has had years of experience and sees a number of cases.

Now then Dr. Fuller's statement requires a few words. There is a certain malacia of the spinal cord of the profession, which makes them afraid to assert themselves. No such thing as this chiropractic propaganda would appear in the newspapers if we were not afraid. If you should contradict that in the newspaper, you would be heralded as an advertiser. It is only by the dissemination of knowledge among the laity that we can get rid of such people as chiropractors, Christian science practitioners, and similar healers. But we must have cooperation among ourselves and not fear criticisms when we contradict these fakes through the lay press.

Dr. Thomas L. Gilmer: It has been my good fortune to have been present when Dr. McArthur did most of the operations he speaks of and I fully corroborate what he has said about the results. I have seen some of these patients at frequent intervals for a number of years.

Many years ago I observed the result of certain surgical procedures which compelled me to believe that entirely too much mutilization of the jaws, especially of the mandible, was done for the cure of the benign epulis, giant-cell sarcoma, odontomes, dentigerous and other cysts found in the mouth. The most common tumor of the jaw is the benign epulis, and it never requires a mutilating operation for its removal, neither does the giant-cell sarcoma which is not specifically malignant.

Unnecessary mutilation of the tissues of the jaws led me to write a paper which I read before the Stomatological Section of the American Medical Association in 1909 on "Conservative Surgery for the Treatment of Diseases of the Mandible." In this paper, I not only made a plea for less radical

operations for benign growths but at the same time, made a plea for less mutilating surgery in the treatment of some of the malignant growths of the mandible.

In a few cases of carcinoma of the mandible when I discovered the disease early, before there had been involvement of the base of the jaw, the disease having been confined to the superficial parts of the alveolar process, I cut away all of the alveolar portion of the mandible, leaving only a narrow strip of the cortical portion of the base of the jaw which was sufficient to preserve its continuity.

The first operation of this kind that I performed was 15 years ago and the patient still lives and there has been no recurrence. I have treated other similar cases in exactly the same way, which have remained well over a period of a number of years. In all of these cases, the tissues was examined in the laboratory at St. Luke's Hospital and a definite diagnosis made of carcinoma.

The question that Dr. McArthur has raised, it seems to me, he has answered himself in the results that he has obtained in the cases cited. He has certainly been justified, as any of our other surgeons would be, in determining procedures by the conditions observed at the time.

The rules laid down by the textbook on this subject as taught 10 or 20 years ago are of little present value, and it seems to me that any surgeon with the reputation of Dr. McArthur should feel that he is, in no way bound by the dictum of the textbook that goes contrary to his experience and belief in these matters.

Dr. L. L. McArthur (closing): I am very much obliged to you for your patience. Inasmuch as some of the cases were operated upon 20 years ago, I feel the results are conclusive of cure.

I had hoped that something might enter the records from the discussion tonight so that if in the future some surgeon using his head, violated the rules taught by the best surgeons, and in our best textbooks should by any mischance have a medico-legal aspect arise from it, some record might be here that would protect him from unfair criticism and undue financial damage. Hedge the case about very carefully by explaining to the patient and his family, give it in writing if you desire,—that you are about to violate the rules if you see justification, then go ahead and do it. There are times when you will be very much pleased indeed that you have done it. Let no man here take advantage of this statement and the argument I have made tonight to do a minor operation because he is afraid to do the major operation. You may have recurrence and you will have to take active steps immediately if anything shows but go ahead, sometimes you will be very glad that you violated those rules which you teach students and which should not apply infallibly and without exception to the surgeon.

Dr. Carl Beck read a paper on "Treatment of Large Empyema Cavities" and demonstrated a patient.

# AMERICAN COLLEGE OF SURGEONS

## THE DEPARTMENT OF LITERARY RESEARCH OF THE AMERICAN COLLEGE OF SURGEONS

TO meet a growing need which has been voiced by Fellows of the College during the past year, the Department of Literary Research has been organized in association with the new College Library, and has entered upon its field of service to Fellows of the College and to members of the surgical profession. The Department is now ready to assist surgeons and workers in closely allied branches of medicine in their literary work through the preparation of bibliographies, abstracts, and translations on any given subject related to general surgery or to the surgical specialties, the compilation of such material, or any other editorial work which may be desired. Exhaustive literary researches in fields pertaining to surgery will be gladly undertaken. Such work will include a thorough search of the literature on the particular subject under investigation, the preparation of special and comprehensive bibliographies, and a careful collection of the material from the original sources. All inquiries regarding previous work in any particular field related to surgery will be answered as promptly as possible, and data concerning papers, books, and monographs on surgical subjects will be gladly furnished. For such work the Department will have the use of the John Crerar Medical Library, one of the largest in the country, until the reference department of the College Library is fully developed.

In association with the Department on Hospital Standardization, an index and cross reference file of current hospital literature is being prepared, and will be available for the use of those interested in hospital problems.

To further the more thorough study of scientific literature and its more careful preparation will be the aim of the new Department; and to this end it is ready to serve the Fellows of the College and the members of the surgical profession of America. It is hoped that it may be of value both to the surgeon who is too busy to devote hours to library research and to the one who is far removed from medical centers and libraries. The purpose is in nowise to furnish a "shortcut" to the publication of numerous medical papers and books, but rather to help in the standardization of surgical literature.

For the various types of literary assistance which have been outlined, a minimum charge will be made to cover the actual expense of the work.

# PROVINCIAL AND STATE CLINICAL MEETINGS

MEETINGS of provincial and state sections of the Clinical Congress of the American College of Surgeons were held during August as follows: Calgary, Alberta, August 18 and 19; Vancouver, British Columbia, August 22 and 23; Spokane, Washington, August 25 and 26; and Portland, Oregon, August 29 and 30. At each meeting there were clinical, scientific, and public sessions and a hospital conference on standardization. The programs follow:

## ALBERTA

### THURSDAY, AUGUST 18

*Clinics*

At the Calgary General, Holy Cross, and Col. Belcher Hospitals, 9 a.m. to 12:30 p.m.

*Hospital Conference, 2 p.m.*

Edgar W. Allin, M.D., Edmonton, Chairman, presiding.
Summary of Work in Hospital Standardization by the American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Soul of Hospital Standardization—Reverend C. B. Moulinier, S. J., President, Catholic Hospital Association.
What Canada is Doing in the Standardization of Hospitals—Malcolm T. MacEachern, M.D., General Superintendent, Vancouver General Hospital.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—L. S. Mackid, M.D., Calgary.
General Discussion—William A. Lincoln, M.D., Calgary, and John Osborn Polak, M.D., Brooklyn.

*Public Meeting, 8 p.m.*

Edgar W. Allin, M.D., Edmonton, Chairman, presiding.
Address of Welcome—Mayor S. H. Adams.
Address—Lieutenant-Governor Brett.
The American College of Surgeons—Franklin H. Martin, M.D., Chicago.
What Can Be Accomplished by Routine Prenatal Care—John Osborn Polak, M.D., Brooklyn.
The Standardization of Hospitals—Malcolm T. MacEachern, M.D., Vancouver.
The Community's Interest in Hospitals—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.

### FRIDAY, AUGUST 19

*Clinics*

At the Calgary General, Holy Cross, and Col. Belcher Hospitals, 9 a.m. to 12:30 p.m.

*Scientific Session, 2:30 p.m.*

Forced Labor; Its Present Status—John Osborn Polak, M.D., Brooklyn.
Surgical Shock and Allied Conditions—Alex. R. Munroe, M.D., Edmonton.
Tubercular Disease of the Knee—F. W. Gershaw, M.D., Medicine Hat.
Organization for Better Surgery—Franklin H. Martin, M.D., Chicago.
General Discussion on the Clinical Work Presented at the Hospital.

## BRITISH COLUMBIA

### MONDAY, AUGUST 22

*Clinics*

At the Vancouver General Hospital, 9 a.m. to 1 p.m.

*Hospital Conference, 2:30 p.m.*

Summary of Work in Hospital Standardization by the American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Soul of Hospital Standardization—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.
What Canada Is Doing in the Standardization of Hospitals—Malcolm T. MacEachern, M.D., General Superintendent, Vancouver General Hospital.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—Robert E. McKechnie, M.D., Vancouver.
General Discussion—A. S. Monro, M.D., Vancouver, and John Osborn Polak, M.D., Brooklyn.

*Public Meeting, 8 p.m.*

I. Glen Campbell, M.D., Vancouver, Chairman, presiding.
Address of Welcome—His Worship, Mayor R. H. Gale, Vancouver.
The American College of Surgeons—Franklin H. Martin, M.D., Chicago.
The Standardization of Hospitals—Malcolm T. MacEachern, M.D., Vancouver.
What Can be Accomplished by Routine Prenatal Care—John Osborn Polak, M.D., Brooklyn.
The Community's Interest in Hospitals—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.

### TUESDAY, AUGUST 23

*Clinics*

At the Vancouver General Hospital, 9 a.m. to 12 m.

*Scientific Session, 2 p.m.*

Organization for Better Surgery—Franklin H. Martin, M.D., Chicago.
Goitre—Robert E. McKechnie, M.D., Vancouver.
Forced Labor; Its Present Status—John Osborn Polak, M.D., Brooklyn.
Fractures and Dislocations of the Atlas (Illustrated)—Robert Forbes, M.D., Seattle.
Diagnosis of Ectopic Gestation—Lachlan Macmillan, M.D., Vancouver.

## WASHINGTON

### THURSDAY, AUGUST 25

*Clinics*

At the Sacred Heart, St. Lukes, and Deaconess Hospitals, 8:30 a.m. to 12:30 p.m.

*Hospital Conference, 2 p.m.*

Charles F. Eikenbary, M.D., Chairman, presiding.
Summary of Work in Hospital Standardization by the American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Soul of Hospital Standardization—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.
The Result of Standardization, from the Surgeon's Viewpoint—Joseph A. Pettit, M.D., Portland.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—A. T. R. Cunningham, M.D., Spokane.
Experience with the Standardization Program of the American College of Surgeons, from the Standpoint of the Medical Director—Burton A. Brown, M.D., Medical Director, Seattle City Hospital.
General Discussion—Led by George W. Swift, M.D., Seattle; Nils A. Johanson, M.D., Seattle, and John Osborn Polak, M.D., Brooklyn.

*Public Meeting, 8 p.m.*

Charles F. Eikenbary, M.D., Chairman, presiding.
Address of Welcome—M. M. Higley, President of the Board of Trustees, Deaconess Hospital, Spokane.
The American College of Surgeons—Franklin H. Martin, M.D., Chicago.
What Can Be Accomplished by Routine Prenatal Care—John Osborn Polak, M.D., Brooklyn.
The Importance of the Early Recognition of Cancer—Joseph A. Pettit, M.D., Portland.
What Everyone Should Know about Cancer—Ernest F. Tucker, M.D., Portland.
The Community's Interest in Hospitals—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.

FRIDAY, AUGUST 26

*Clinics*

At the St. Luke's, Sacred Heart, and Deaconess Hospitals, 8:30 a.m. to 12:30 p.m.

*Scientific Session, 2 p.m.*

Charles F. Eikenbary, M.D., Chairman, presiding.
Organization for Better Surgery—Franklin H. Martin, M.D., Chicago.
Forced Labor; Its Present Status—John Osborn Polak, M.D., Brooklyn.
Discussion by Robert N. Hamblen, M.D., Spokane, and Edward J. Lawrence, M.D., Spokane.
Surgical Consideration of Goitre—Joseph A. Pettit, M.D., Portland.
The Cancer Problem—Ernest F. Tucker, M.D., Portland.
Discussion opened by Frederick Epplen, M.D., Spokane.

## OREGON

MONDAY, AUGUST 29

*Clinics*

At the St. Vincent's, Portland Surgical, Good Samaritan, and the Portland Eye, Ear, Nose and Throat Hospitals, 8 a.m. to 12 m.

*Hospital Conference, 2:30 p.m.*

Andrew C. Smith, M.D., Portland, Chairman, presiding.
Summary of Work in Hospital Standardization by the American College of Surgeons—Franklin H. Martin, M.D., Secretary-General, American College of Surgeons.
The Surveyor's Work in the Standardization of Hospitals—Thaddeus E. Allen, Chicago.
The Soul of Hospital Standardization—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.
What Canada is Doing in the Standardization of Hospitals—Malcolm T. MacEachern, M.D., General Superintendent, Vancouver General Hospital.
Experience with the Standardization Program of the American College of Surgeons, from the Surgeon's Standpoint—Robert C. Coffey, M.D., Portland.
Experience with the Standardization Program of the American College of Surgeons, from the Hospital Superintendent's Standpoint—Reverend Axel M. Green, Superintendent, Emanuel Hospital, Portland.
General Discussion: The Rt. Rev. Walter Taylor Sumner, D.D., Bishop of Oregon; J. Earl Else, M.D., Portland, and John Osborn Polak, M.D., Brooklyn.

*Public Meeting, 8 p.m.*

Andrew C. Smith, M.D., Portland, presiding.
The American College of Surgeons—Franklin H. Martin M.D., Chicago.
What the Public Can Do to Reduce the Dangers of Cancer—Allen B. Kanavel, M.D., Chicago.
What Can Be Accomplished by Routine Prenatal Care—John Osborn Polak, M.D., Brooklyn.
The Community's Interest in Hospitals—Reverend C. B. Moulinier, S.J., President, Catholic Hospital Association.

TUESDAY, AUGUST 30

*Clinics*

At the Portland Surgical, Good Samaritan, St. Vincent's, and Portland Eye, Ear, Nose and Throat Hospitals, 8 a.m. to 12 m.

*Scientific Session, 2:30 p.m.*

Andrew C. Smith, M.D., Portland, presiding.
Organization for Better Surgery—Franklin H. Martin, M.D., Chicago.
Surgical Experience and Studies in Trigeminal Neuralgia—Allen B. Kanavel, M.D., Chicago.
Forced Labor; Its Present Status—John Osborn Polak, M.D., Brooklyn.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

ELEVENTH ANNUAL SESSION, PHILADELPHIA, OCTOBER 24–28, 1921

GEORGE E. ARMSTRONG, Montreal, *President*
JOHN B. DEAVER, Philadelphia, *President-Elect* ALBERT J. OCHSNER, Chicago, *Treasurer*
FRANKLIN H. MARTIN, Chicago, *Secretary-General*

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GEORGE M. COATES, J. D. ELLIOTT, JOHN H. JOPSON, FLOYD E. KEENE, W. ESTELL LEE, WILLIAM T. SHOEMAKER, J. E. SWEET, B. A. THOMAS

## THE CLINICAL CONGRESS IN PHILADELPHIA

THE tentative schedule of clinics and demonstrations as published in the following pages gives one a splendid idea of the variety and scope of the clinical work to be demonstrated at the eleventh annual session of the Clinical Congress of the American College of Surgeons to be held in Philadelphia, October 24 to 28. The published schedule is a tentative one; the real program of the Congress will be bulletined at headquarters each afternoon during the session and will present an accurate and detailed list of the operative clinics and demonstrations to be given in the several hospitals and medical schools. All departments of surgery, including gynecology, obstetrics, orthopedics, urology, surgery of the eye, ear, nose, throat, and mouth, experimental surgery, surgical pathology, roentgenology, etc., will be represented in the program.

In addition, two series of special clinical demonstrations have been arranged. The first series comprises group clinics dealing with important subjects in surgery and are to be held in the afternoons at the several teaching hospitals —University, Jefferson, Pennsylvania, Medico-Chirurgical, Hahnemann, etc. At these clinics all departments of medicine will be represented, bringing to bear the latest thought in medical and surgical care.

The second series of special clinical demonstrations have been arranged for the morning hours, and are to be held at the Bellevue-Stratford, and will be of especial interest to those practicing surgery of the eye, ear, nose, and throat. A detailed program of these demonstrations will be found in the following pages.

At the Presidential Meeting on Monday evening in the Ballroom of the Bellevue-Stratford, the distinguished foreign guests will be presented, and the President-elect, Dr. John B. Deaver of Philadelphia, will deliver his inaugural address. On the same evening Dr. William J. Mayo of Rochester will deliver the John B. Murphy oration in surgery. On Tuesday, Wednesday, and Thursday evenings, papers dealing with surgical subjects will be read and discussed by a number of distinguished European and American surgeons. A complete program for these evening sessions will be found in the following pages.

### HOSPITAL DAY—MONDAY

An innovation will be introduced at the Clinical Congress this year in that the first day will be known as "Hospital Day," to be devoted to a discussion of hospital problems. The annual approved list of hospitals which, on inspection, fulfilled the requirements of the minimum standard of the American College of Surgeons, will be released on this day also. Authorities on hospital activities and officials of various hospital organizations will participate in the program. Complete programs with names of the individual speakers will be mailed to those interested in hos-

pital problems previous to the meeting. The sessions will be held in the Rose Garden at the Bellevue-Stratford Hotel.

*9:30 A.M.*

1. Hospital conference, dealing with the standardization program of the American College of Surgeons, including its present and future status.

Representative speakers from the following organizations have been invited to participate: The American Hospital Association, the Catholic Hospital Association, the Protestant Hospital Association, the Methodist Hospital Association, Provincial Hospital Associations of Canada, the Association of American Railway Surgeons, as well as various surgeons, hospital superintendents, and members of boards of trustees.

*2:30 P.M.*

1. The Industrial Hospital.—This subject will be presented by two representative speakers followed by a general discussion.

2. The Nursing Problem.—What shall be the standard curriculum for hospital nurses? Shall there be a lower standard for the so-called "practical nurse"? Shall there be supplementary training for nurses desiring administrative or other special positions?

These subjects will be developed by a small group of hospital superintendents, officials of various nursing organizations, and hospital staff members.

*4:00 P.M.*

Round-table discussion: "What Constitutes Good Service to the Patient." Conducted by a group of hospital superintendents and staff surgeons.

COLLEGE CONVOCATION

Sir Harold J. Stiles of Edinburgh, Scotland, will deliver the fellowship address at the ninth annual convocation of the American College of Surgeons to be held in the Ballroom of the Bellevue-Stratford on Friday evening, at which time fellowship in the College will be conferred upon a large group of American and Canadian surgeons and honorary fellowships upon the distinguished foreign guests.

An interesting and decidedly unique feature of the convocation will be the conferring of honorary fellowships in the Royal College of Surgeons of Ireland upon a group of distinguished American surgeons. Sir William I. de Courcy Wheeler, Vice-President, Sir Robert Hy Woods, past President, and Sir William Taylor, K.B.E., C.B., past President, representing the Irish College, will confer fellowships upon the following: George E. Brewer, George W. Crile, John M. T. Finney, Richard H. Harte, William W. Keen, Charles H. Mayo, William J. Mayo, Albert J. Ochsner.

REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized the sale of round-trip tickets to Philadelphia on account of the Clinical Congress, at one and one-half the ordinary first-class one-way fare except within the state of Pennsylvania. This arrangement requires that the journey shall be made by the same route both going to and returning from Philadelphia. Round-trip tickets at this special rate will be sold to members only upon presentation of identification certificates which will be issued to members upon request from the office of the Secretary-General, 40 E. Erie Street, Chicago. One certificate is sufficient for a member and dependent members of his family. Under the special arrangement made, round-trip tickets will be sold from October 20 to 26 with a return limit of November 3, except in the far western states and the western provinces of Canada, where the first selling date is October 19 with a return limit of November 4.

The reduction in fares does not apply to Pullman fares or to excess fares charged for passage on certain trains. Local railway ticket agents will supply detailed information with regard to rates, routes, etc.

SPECIAL TRAIN FROM CHICAGO

For the convenience of members from the West who expect to attend the meeting in Philadelphia, the Pennsylvania Railway will undertake to provide a special train leaving Chicago at 1 p.m. standard time, Sunday, October 23, arriving in Philadelphia at 9 a.m. on Monday, October 24. Such special train will duplicate the equipment and schedule of the Broadway Limited, including standard Pullman sleeping, compartment, club, observation, and dining cars. This arrangement is contingent upon reservations for such special train being made by the minimum number required by the Interstate Commerce Commission rules. No extra fares will be charged for passage on such special train. Members are urged to make their reservations for this special train at the earliest possible date.

PHILADELPHIA HOTELS

In addition to the Bellevue-Stratford, the headquarters' hotel, there are many first-class hotels in Philadelphia. However, as the Congress will bring to Philadelphia a large number of people, it is urged that members make their hotel reservations immediately. If difficulty is experienced in securing accommodations, members should write to Dr. Damon B. Pfeiffer, 2028 Pine Street, Philadelphia, Secretary of the Committee on Arrangements, who will be glad to assist them in securing hotel accommodations.

The following hotels are recommended by the local Committee on Arrangements:

Adelphia, 13th and Chestnut.
Aldine, 19th and Chestnut.
Belgravia, 1811 Chestnut.
Bellevue-Stratford, Broad and Walnut.
Blenheim, 17th and Chestnut.
Colonial, 11th and Spruce.
Colonnade, 15th and Chestnut.
Continental, 9th and Chestnut.
Dooner's, 23 S. 10th.
Green's, 8th and Chestnut.
Hanover, 12th and Arch.
Longacre, 1431 Walnut.
Lorraine, Broad and Fairmount.
Majestic, Broad and Girard.
Rittenhouse, 22nd and Chestnut.
Ritz-Carlton, Broad and Walnut.
Royal Apartments, Broad and Girard.
St. James, 13th and Walnut.
Stenton, Broad and Spruce.
Vendig, 13th and Filbert.
Walton, Broad and Locust.
Windsor, 1217 Filbert.

### HEADQUARTERS

General headquarters for the Congress will be at the Bellevue-Stratford Hotel where the entire first floor has been reserved for the use of the Congress. The large Ballroom will be utilized for the evening sessions, certain clinical demonstrations, business meetings, etc., while the Clover, Red, Green, and other large rooms and foyers on the same floor will provide ample space for registration and ticket bureaus, bulletin rooms, etc. Headquarters will be open for registration Monday morning, October 24. The clinical program for Tuesday will be bulletined at headquarters that afternoon.

### LIMITED ATTENDANCE—ADVANCE REGISTRATION

Because of the popularity of these annual clinical meetings it has been found necessary in recent years to adopt the plan of limiting the attendance, requiring registration in advance on the part of those who wish to attend. A survey of the amphitheaters, lecture rooms, and laboratories in the several hospitals and medical schools, as to their capacity for accommodating visitors, has been made and the limit of attendance based thereon.

This plan insures accommodations at the clinics for all who register in advance, and the necessity for adopting such a plan will be apparent to all. Based upon our experience at previous meetings, it is probable that the limit of attendance will be reached weeks in advance of the meeting. When the limit of attendance has been reached through advance registration, no further applications can be accepted.

### CLINIC TICKETS

Attendance at all clinics and demonstrations is controlled by means of special clinic tickets, the number of tickets issued for any clinic or demonstration being limited to the capacity of the room in which the clinic or demonstration is to be given.

Clinic tickets will be issued at headquarters each morning at 8 o'clock for the clinics and demonstrations to be given that day. Each afternoon a complete schedule of the following day's clinics will be posted on bulletin boards at headquarters. After the program has been posted, reservations for tickets for the clinics may be filed, the tickets to be issued the following morning. Printed programs will be issued each morning.

### REGISTRATION FEE

A registration fee of $5.00 is required of each surgeon attending the annual clinical meeting, the receipts from registration fees providing the funds with which to meet the expenses of conducting the meeting, so that no financial burden is imposed upon the members of the profession in the city entertaining the Congress.

A formal receipt for the registration fee is issued to each surgeon registering in advance, which receipt is to be exchanged for a general admission card at headquarters upon his arrival in Philadelphia. This card, which is non-transferable, must be presented to secure clinic tickets and admission to the evening meetings.

# PRELIMINARY CLINICAL PROGRAM

## PRESBYTERIAN HOSPITAL

*Tuesday, October 25*

J. H. Jopson and D. B. Pfeiffer—9. General surgery.
A. B. Gill—12. Orthopedics.
J. H. Girvin—2. Gynecology.
Ralph Pemberton—2. Present status of pathology and treatment of arthritis, with exhibition of patients.
Ralph Pemberton, B. A. Thomas, N. P. Stauffer, J. E. Aiguier and assistants—2:45. Brief analysis of incidence of various types of focal infection in one hundred consecutive admissions to the medical service.
A. B. Gill—3. Treatment of tuberculous arthritis (exhibition of patients).
J. H. Jopson—3:30. Discussion of fractures into joints.
H. P. Brown—4. Results of Willems' treatment.

*Wednesday, October 26*

G. E. Shoemaker—9. Gynecology.
B. A. Thomas—2. Urology.

*Thursday, October 27*

John Speese, J. S. Rodman and H. P. Brown—9. General surgery.

*Friday, October 28*

J. H. Jopson and D. B. Pfeiffer—9. General surgery.
N. P. Stauffer—2. Nose and throat.

## HOWARD HOSPITAL

*Tuesday, October 25*

A. C. Wood—9. General surgery.
E. L. Eliason—11. General surgery.
George B. Wood—2. Nose and throat.
R. J. Hunter and S. Cohen—3. Nose and throat operations.

*Wednesday, October 26*

Bernard Mann—9. Gynecology.
Barton Cooke Hirst—11. Gynecology.
W. C. Posey—2. Eye clinic.

*Thursday, October 27*

A. C. Wood—9. General surgery.
E. L. Eliason—11. General surgery.
George B. Wood—2. Nose and throat.

*Friday, October 28*

Bernard Mann—9. Gynecology.
Barton Cooke Hirst—11. Gynecology.
W. C. Posey—2. Eye clinic.

## CHILDREN'S HOSPITAL (MARY J. DREXEL HOME)

*Wednesday, October 26*

Ralph Butler—8. Mastoid operations.
N. L. Knipe—2. Ophthalmology.

*Friday, October 28*

H. C. Deaver and E. G. Alexander—10:30. General surgery.

## PENNSYLVANIA HOSPITAL

*Tuesday, October 25*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
Drs. LeConte, Lee, and Brown—11. General surgery.
L. J. Herman—1. Genito-urinary surgery.
E. A. Strecker—1. Neurology.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
Drs. Shoemaker and Crampton—2. Eye clinic.

*Wednesday, October 26*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
G. W. Norris—10. Medical clinic.
Drs. Gibbon, Billings, and Klopp—11. General surgery.
Drs. Shoemaker and Crampton—2. Eye clinic.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
F. C. Knowles—2. Skin.

*Thursday, October 27*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
D. R. Bowen—10. Roentgenology.
Dr. Newcomer—10. Surgical pathology.
A. Newlin—10. Medical clinic.
Drs. Mitchell, Lee, and Brown—11. General surgery.
L. J. Herman—1. Genito-urinary surgery.
Drs. Newcomer, Davis, and Knowles—2. Syphilis: Salvarsan.
E. A. Strecker—2. Neurology.
Drs. Shoemaker and Crampton—2. Eye clinic.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.

*Friday, October 28*

W. D. Stroud—9. Electrocardiogram.
Dr. MacMillan—9. Basal metabolism.
Dr. Newcomer—10. Surgical pathology.
D. R. Bowen—10. Roentgenology.
T. McCrae—10. Medical clinic.
Drs. Gibbon, Billings, and Klopp—11. General surgery.
Drs. Packard, Eves, and Davies—2. Ear, nose, and throat.
Drs. Shoemaker and Crampton—2. Eye clinic.

## ST. CHRISTOPHER'S HOSPITAL

*Tuesday, October 25*

Frederick Krauss—2. Mastoid clinic.
R. R. Willoughby—4. Tonsil and adenoid operations.

*Wednesday, October 26*

Robert Gray—9. Orthopedic operations.
E. G. Alexander—11. General surgery.

*Thursday, October 27*

C. A. Currie—10:30. Tonsil and adenoid operations.
Dr. Adams—2. Operative eye clinic.

## JEFFERSON HOSPITAL

*Tuesday, October 25*

J. T. Rugh—9. Orthopedics.
E. P. Davis—10. Obstetrics.
Arthur Billings—11. General surgery.
P. B. Bland—11. Gynecology.
Drs. Patterson and Mohler—11. Electro-cardiology as an aid to surgery.
F. O. Lewis—12:30. Laryngology.
W. F. Manges—12:30. Roentgenology.
Brooke Anspach—2. Gynecology.
W. M. L. Coplin and staff—2. Pathological museum.
John H. Gibbon—4. General surgery.
H. A. Hare—5. Lecture on therapeutics.

*Wednesday, October 26*

Thomas Shallow—9. General surgery.
Chevalier Jackson—10. Bronchoscopy.
W. P. Hearn—11. General surgery.
John Fisher—11. Gynecology.
T. C. Stellwagon—12. Genito-urinary surgery.
S. MacCuen Smith and J. C. Keeler—12. Otology.
J. C. DaCosta—2. General surgery.
Dr. Coplin and staff—2. Pathological museum.
H. A. Hare—4. Wiring for aortic aneurism; posture of head in anæsthesia.
Dr. Beadsley—4. Lecture on medicine.
E. P. Davis—5. Lecture on obstetrics.

*Thursday, October 27*

M. E. Rehfuss—9. Surgical aspect of gastric cases; pseudo-appendicitis.
H. R. Loux—10. Genito-urinary clinic.
A. J. Davidson—11. Orthopedics.
John H. Gibbon—11. General surgery.
B. B. Vincent Lyon—11. Non-surgical drainage of gall-bladder.
William S. Newcomet—11:30. Radium clinic.
Drs. Loux, Stellwagon, Kinney, and Newcomet—12. Genito-urinary surgery.
W. F. Manges—12:30. Roentgenology.
F. O. Lewis—12:30. Laryngology.
T. McCrae—2. Medical clinic.
E. J. Klopp—2. General surgery.
J. Coles Brick—3. Diseases of the rectum.
S. Solis Cohen—4. Medical clinic.
E. E. Graham—5. Lecture on diseases of children.

*Friday, October 28*

J. C. DaCosta—9. Lecture on general surgery.
F. X. Dercum—10. Clinic on nervous diseases.
D. L. Despard—10. General surgery.
John H. Gibbon—11. General surgery.
Drs. Patterson and Mohler—11. Electro-cardiology.
Dr. S. MacCuen Smith and staff—12:30. Otology.
W. F. Manges—12:30. Roentgenology.
F. C. Knowles—2. Clinic on skin diseases.
Drs. Hansell and Sweet—3. Eye clinic.

## KENSINGTON HOSPITAL FOR WOMEN

*Wednesday, October 26*

E. G. Alexander—9. Gynecology.
H. C. Deaver—11. Gynecology.

*Friday, October 28*

Daniel Longaker—9. Obstetrics.
W. E. Parke—11. Gynecology.

## UNIVERSITY HOSPITAL

*Tuesday, October 25*

B. C. Hirst, E. B. Piper, and J. C. Hirst, 2nd—9. Obstetrics and gynecology.
George G. Ross—9. Hernia operations.
F. E. Keene and Charles C. Norris—9. Gynecology.
J. B. Carnett—11. General surgery.
E. L. Eliason—12. General surgery.
A. B. Gill—10. Orthopedics.
B. C. Hirst, E. B. Piper, J. C. Hirst, 2nd., and C. C. Wolferth—2. Obstetrical and gynecological complications; cardiac conditions complicating pregnancy.
J. E. Sweet—2. Experimental surgery.
A. B. Gill—2. Orthopedics.
Charles H. Frazier—3:30. Surgery of the nervous system.

*Wednesday, October 26*

Charles H. Frazier and Francis Grant—9:30. Surgery of the nervous system (operations).
F. E. Keene and Charles C. Norris—9. Gynecology.
D. B. Pfeiffer—9. General surgery.
Thomas R. Neilson and Alex Randall—11. Urology.
George P. Muller and H. K. Pancoast—2. Malignant disease of the face and mouth.
F. E. Keene and Charles C. Norris—2. Gynecological demonstration.
J. E. Sweet—2. Experimental surgery.
H. K. Pancoast—3. Roentgenology.
D. B. Pfeiffer—3. Rectal carcinoma.
T. T. Thomas—3:30. Shoulder dislocations.
J. B. Carnett and E. L. Eliason—4. Demonstrations of a fracture.

*Thursday, October 27*

B. C. Hirst, E. B. Piper, J. C. Hirst, 2nd—9. Gynecology and obstetrics.
F. E. Keene and Charles C. Norris—9. Gynecology.
George P. Muller—9. Surgery of the chest.
C. H. Frazier and Francis Grant—9:30. Neurological surgery.
A. B. Gill—10. Orthopedics.
T. T. Thomas—11. General surgery.

*Friday, October 28*

F. E. Keene and Charles C. Norris—9. Gynecology.
A. C. Wood—9. General surgery.
C. H. Frazier and Francis Grant—9:30. Surgery of the nervous system and goiter.
John B. Deaver—10:30. General surgery.
J. E. Sweet—2. Experimental surgery.
Charles E. Grayson—2. Otolaryngology.
Charles H. Frazier and Francis Grant—2. Surgery of the nervous system and goiter.
H. K. Pancoast—3. Roentgenology.
Drs. Deaver, Wood, Ross, Muller, Carnett, Eliason, Pfeiffer, Stengel, Pepper, Fox, Richards, Miller, Wolferth, Kern—3. Joint clinic on medical aspect of surgical cases and vice versa.

## ORTHOPEDIC HOSPITAL

*Tuesday, October 25*

A. Bruce Gill—9. Orthopedics.
William J. Taylor—11. Orthopedics.
A. P. C. Ashhurst and Edward T. Crossan—2. Demonstration: tarsectomy for rigid flat foot, inveterate club foot, and equinovarus; birth injuries of shoulders; lacerations of brachial plexus.

## MEDICO-CHIRURGICAL HOSPITAL

*Tuesday, October 25*

GEORGE P. MULLER and staff—9. Surgical clinic—operations and demonstrations.
J. A. KOLMER and E. A. CASE—9:30. Demonstration—frozen section work.
E. A. MCKNIGHT—2. Demonstration—fractures of the forearm.
R. H. SKILLERN—2. Sinus clinic.
R. F. RIDPATH—2. Tonsil clinic.
WILLIAM BATES—2:15. Demonstration—fractures of the tibia and fibula.
B. R. BELTRAN—2:30. Demonstration—fractures of the femur.
I. S. RAVDIN—2:45. Demonstration—postoperative cases of compound fracture.
T. T. THOMAS—3:00. Recurrent dislocation of the hip and shoulder. Demonstration of cases and anatomical specimens.
L. W. FOX—3. Ophthalmic clinic.
JOHN H. JOPSON—3:30. Demonstration—fractures of the carpal and tarsal bones.
GEORGE P. MULLER—3:45. Demonstration—fractures of the skull.
ROBERT H. IVY—4. Demonstration—fractures of the mandible.

*Wednesday, October 26*

JOHN H. JOPSON—9. Surgical clinic.
WILLIAM R. NICHOLSON and staff—9. Gynecology.
GEORGE W. OUTERBRIDGE—2. Demonstration—cystoscopy.
G. M. COATES—2. Tonsil clinic.
M. ERSNER—2. Tonsil clinic.
T. F. JAFFE—2:15. Demonstration—gynecological models
WILLIAM R. NICHOLSON—2:30. Demonstration—postoperative gynecological cases.
DEFORREST P. WILLARD—2:45. Demonstration—cases of hip joint disease.
WALTER G. ELMER—3. Demonstration—cases of Potts' disease.
JAMES M. ANDERS—3:15. Demonstration—cases of aneurism.
GEORGE M. PIERSOL and staff—3:30. Demonstration of cases for gastro-enterologic study.
MRS. M. S. STEELE—3:45. Speech clinic.
MISS H. E. KIRSH—4. Surgical social service.

*Thursday, October 27*

ERNEST LAPLACE and staff—9. Surgical clinic and demonstrations.
GEORGE M. BOYD and staff—9. Gynecological clinic.

*Friday, October 28*

J. B. CARNETT—9. Surgical clinic.
M. B. MILLER—9. Surgical clinic.
GEORGE E. PFAHLER—2. Electro-coagulation clinic with demonstration of cases.
DRS. SKILLERN, RIDPATH, COATES and ERSNER—2. Nose and throat clinic.
L. W. FOX—2. Ophthalmic clinic.
ROBERT H. IVY—3. Demonstration—postoperative results in maxillofacial surgery.
M. B. MILLER—3:15. Demonstration of cases of cervical-adenitis treated with tuberculin.
J. STEWART RODMAN—3:30. Demonstration—neurological surgery.
P. G. SKILLERN—3:40. Demonstration—new method in operative technique.

## LANKENAU HOSPITAL

*Tuesday, October 25*

W. E. DODD—9:30. A study of diverticulitis of the colon (lantern demonstration).
S. P. REIMANN—10. Simplified apparatus for estimation of basal metabolism. Surgical pathological demonstration. Experimental studies of the gall-bladder.
F. L. HARTMANN—11. Experiences with the duodenal string and tube in relation to diagnosis and treatment.
A. G. MILLER and R. SHOEMAKER, III—11:30. Compact portable unit for bedside roentgenology. Fractures and joint injuries.
JOHN B. DEAVER—2. General surgery.
H. F. PAGE, A. D. WHITING, F. L. HARTMANN, and MISS JASTROW—2. Demonstration of follow-up system with practical conclusions derived from study of groups of cases such as chronic appendicitis, pelvic disorders, visceroptosis, etc.
R. BUTLER—2. Otolaryngology.
W. H. MACKINNEY and W. H. HAINES—3. Urology.
JOHN. B. DEAVER—4. General surgery.
H. F. PAGE, A. D. WHITING, F. L. HARTMANN and MISS JASTROW—4. Follow-up system.

*Wednesday, October 26*

W. E. DODD—9:30. A study of diverticulitis of the colon.
S. P. REIMANN—10. Simplified apparatus for estimation of basal metabolism. Surgical pathological demonstration. Experimental studies of the gall-bladder.
F. L. HARTMANN—11. Experiences with the duodenal string and tube in relation to diagnosis and treatment.
A. G. MILLER and R. SHOEMAKER, III—11:30. Compact portable unit for bedside roentgenology. Fractures and joint injuries.
JOHN B. DEAVER—2. General surgery.
H. F. PAGE, A. D. WHITING, F. L. HARTMANN, and MISS JASTROW—2. Demonstration of follow-up system with practical conclusions derived from study of groups of cases such as chronic appendicitis, pelvic disorders, visceroptosis, etc.
J. A. BABBITT—3. Laryngology.
JOHN B. DEAVER—4. General surgery.
H. F. PAGE, A. D. WHITING, F. L. HARTMANN, and MISS JASTROW—4. Follow-up system.

*Thursday, October 27*

W. E. DODD—9. A Study of diverticulitis of the colon.
F. L. HARTMANN—9:20. Experiences with the duodenal string and tube in relation to diagnosis and treatment.
S. P. REIMANN—9:45. Experimental studies of the contractility of the gall-bladder.
A. G. MILLER and R. SHOEMAKER, III—10. Bedside roentgenology. Fractures and joint injuries.
G. G. ROSS—11. Hernia and general surgery.

*Friday, October 28*

H. F. PAGE, A. D. WHITING, F. L. HARTMANN, and MISS JASTROW—9. Follow-up system.
S. P. REIMANN—10:30. Simplified clinical laboratory methods.
A. G. MILLER and R. SHOEMAKER, III—11. Bedside roentgenology. Fractures and joint injuries.
W. H. MACKINNEY and W. H. HAINES—3. Urology.

## WILLS EYE HOSPITAL

STAFF—Daily, 2. Eye operations and demonstration of cases.

## PROTESTANT EPISCOPAL HOSPITAL

*Tuesday, October 25*

A. P. C. Ashhurst and I. M. Boykin—9. General surgery.
Louis H. Mutschler—11. General surgery.
G. Oram Ring—3. Ophthalmology.

*Wednesday, October 26*

A. Bruce Gill—9. Orthopedic operations.
H. G. Goldberg—2. Ophthalmology. Cataract cases.
J. P. Gallagher and E. Collins—3. Ear, nose and throat. Ethmoid cases.

*Thursday, October 27*

H. C. Deaver and E. G. Alexander—9. General surgery.
T. R. Neilson—11. General surgery.
Charles C. Biedert and T. R. Currie—2. Ear, nose and throat operations.

*Friday, October 28*

A. P. C. Ashhurst and Edward T. Crossan—9. General surgery.
A. P. C. Ashhurst and Ralph S. Bromer—2. Dry bone clinic: cystic disease and sarcoma.

## PHILADELPHIA GENERAL HOSPITAL

*Tuesday, October 25*

H. W. Loux—9. General surgery.
J. T. Rugh—11. Orthopedics.
M. M. Franklin—3:30. Orthopedics.

*Wednesday, October 26*

T. T. Thomas—9. General surgery.
E. R. Kirby—12. Genito-urinary surgery.
E. B. Krumbhaar—2. Exhibition of radium plant.
F. O. Lewis—3:30. Laryngology.

*Thursday, October 27*

John Fisher—9. Gynecology.
J. C. Hirst—10:30. Gynecology.

*Friday, October 28*

H. R. Owen—9. General surgery.
R. H. Ivy—11:30. Oral surgery.

## POLYCLINIC HOSPITAL

*Tuesday, October 25*

DeF. P. Willard—9. Orthopedics.
T. B. Holloway—2. Ophthalmology.
R. Butler—2. Nose and throat clinic.

*Wednesday, October 26*

J. K. Young—9. Orthopedics.
L. C. Peter—2. Ophthalmology.
C. B. Gleason—2. Otology.

*Thursday, October 27*

W. C. Elmer—9. Orthopedics.
C. F. Martin—11. Proctology.

*Friday, October 28*

J. B. Roberts—9. Plastic surgery.
B. A. Thomas—2. Urology.
G. B. Wood—2. Tonsil clinic.

## MISERICORDIA HOSPITAL

*Tuesday, October 25*

James A. Kelly—9. General surgery.
Ernest Laplace—9. General surgery.
Cornelius McCarthy—2. Nose and throat.

*Wednesday, October 26*

J. F. X. Jones—9. General surgery.
George P. Muller—9. General surgery.
Thomas F. Byrne—2. Nose and throat.

*Thursday, October 27*

James A. Kelly—9. General surgery.
Ernest Laplace—9. General surgery.

*Friday, October 28*

J. F. X. Jones—9. General surgery.
George P. Muller—9. General surgery.
Louis Love—2. Ophthalmology.

## ST. MARY'S HOSPITAL

*Tuesday, October 25*

Stephen E. Tracy—9. Gynecology.
Joseph C. Ross—11. General surgery.
Ellwood R. Kirby—1. General surgery.
Frank A. Murphy—4. Ophthalmology.

*Wednesday, October 26*

Norman L. Knipe—10. Gynecology.
John H. Boyer—12. General surgery.
Louis J. Burns—2. Laryngology.
William H. Schmidt—4. Electrothermic method with X-ray and radium in treatment of cancer.

*Thursday, October 27*

Howard A. McKnight—10. General surgery.
Frank D. Harris—11. Gynecology.

*Friday, October 28*

William P. Grady—3. Laryngology.
Louis F. Love—4. Ophthalmology.

## JEWISH HOSPITAL

*Tuesday, October 25*

W. H. Teller—9. General surgery.
C. S. Hirsch—9. Urology.
E. Steinfield—10. Serology and bacteriology.
H. M. Goddard—2. Rhinology.
S. L. Feldstein—2. Roentgenology.

*Wednesday, October 26*

F. B. Block—9. Pelvic surgery.
A. Reiss—12. Electrotherapy.
S. F. Feldstein—2. Roentgenology.
C. Stamm—2. Obstetrics.
A. W. Watson—3. Rhinology.

*Thursday, October 27*

M. Behrend—9. General surgery.
E. Steinfield—10. Serology and bateriology.

*Friday, October 28*

C. S. Hirsch—9. Cystoscopy and urology.
L. Brinkman—10. General surgery.
S. L. Feldstein—2. Roentgenology.
G. W. Sholler—2.30. Gyneoclogy.

## ST. AGNES' HOSPITAL

*Tuesday, October 25*

G. M. Dorrance and staff—9. General surgery.
J. M. Fisher—9. Repair of pelvic floor; amputation of cervix; hysterectomy for fibroids of the uterus; hysterectomy for carcinoma of the uterus; operative correction for displacements of the uterus; operations in cases of pelvic inflammatory diseases.
G. M. Dorrance and L. E. McCrea—11. Plastic operations on the face and neck with cases showing results of operations.
B. D. Parrish—2. Demonstration of sinus cases with tonsillectomy by the LaForce method, local and general anæsthesia.

*Wednesday, October 26*

J. F. X. Jones and staff—9. General surgery.
John A. McGlinn—9. Gynecology.
W. J. Ryan—11. Demonstration of results in treatment of fractures.
J. P. Mann—2. Demonstration of cases with operation for diseases of the hip joint.

*Thursday, October 27*

G. M. Dorrance—9. General surgery.
J. C. Hirst—9. Clinic on prolapse of the uterus.
J. W. Bransfield—11. Treatment of burns by use of acetic acid method.
E. C. Murphy—11:30. Application of plaster cast in fracture of neck of femur.

*Friday, October 28*

J. F. X. Jones and staff—9. General surgery.
Alfred Heineberg—9. Uterine endoscopy.
J. F. X. Jones and W. J. Ryan—2. Demonstration of results of hernia operations.
B. D. Parrish—2. Demonstration of mastoid cases with indications for each.

## SAMARITAN HOSPITAL

*Tuesday, October 25*

H. Hudson—9. Orthopedics.
William A. Steel—10. General surgery.
Wilmer Krusen—12. Gynecology.
Luther C. Peter—2. Ophthalmology.
William A. Hitschler—3. Rhino-laryngology.
J. H. Clark and Eugene Asnis—4. Clinical pathology.

*Wednesday, October 26*

J. O. Bower—9. Malignant disease.
W. Wayne Babcock—10. General surgery.
J. C. Applegate—11. Obstetrics.
Collier F. Martin—12. Rectal surgery.
William E. Robertson—2. Basal metabolism.

*Thursday, October 27*

G. C. Bird—9. X-ray diagnosis.
W. Hersey Thomas—10. Urology.
J. O. Arnold—11. Obstetrics.
Frank Hammond—12. Gynecology.

*Friday, October 28*

William E. Robertson—9. Electrocardiogram.
W. Wayne Babcock—10. General surgery.
Wilmer Krusen—12. Gynecology.
Edwin Mitchell—2. Laryngology.
Henry J. Off—3. Otology.
H. Booker Mills—4. Pediatrics.

## ST. JOSEPH'S HOSPITAL

*Tuesday, October 25*

Joseph M. Spellisy—9. Orthopedics.
John F. X. Jones—10:30. General surgery.
George Morley Marshall and William E. Quicksall—2. Otology and laryngology.
Paul J. Pontius, Charles J. Jones, and T. A. O'Brien—2. Ophthalmology.

*Wednesday, October 26*

James A. Kelly—9. General surgery.
E. E. Montgomery, F. Hurst Maier, and P. Brooke Bland—11. Gynecology.
Paul J. Pontius, Charles J. Jones, and T. A. O'Brien—2. Ophthalmology.

*Thursday, October 27*

Melvin M. Franklin—9. General surgery.
E. E. Montgomery, F. Hurst Maier, and P. Brooke Bland—10:30. Gynecology.

*Friday, October 28*

Charles F. Nassau—9. General surgery.
E. E. Montgomery, F. Hurst Maier, and P. Brooke Bland—11. Gynecology.
George Morley Marshall and William E. Quicksall—2. Otology and laryngology.
Paul J. Pontius, Charles J. Jones, and T. A. O'Brien—2. Ophthalmology.

## METHODIST HOSPITAL

*Tuesday, October 25*

William R. Nicholson—9. Gynecology.
J. H. Baldwin—11. General surgery.
M. F. Percival—11. Roentgenology.
Walter Roberts—2. Nose and throat.
Philip H. Moore—2. Ophthalmology.

*Wednesday, October 26*

G. G. Ross—9. General surgery.
Richard Norris—11. Gynecology and obstetrics.

*Friday, October 28*

J. T. Rugh—9. Orthopedics.
J. L. Herman—11. Genito-urinary surgery.
L. J. Hammond—2. General surgery.

## STETSON HOSPITAL

*Tuesday, October 25*

B. M. Anspach—9. Gynecology.
W. K. Neely—2. Obstetrics.

*Wednesday, October 26*

S. E. Tracy—9. Gynecology. Sterilization and operating room technique.
Carl Lee Felt—2. Laryngology.

*Thursday, October 27*

J. A. Boger and W. T. Ellis—9. General surgery.

*Friday, October 28*

S. E. Tracy—9. Gynecology. Sterilization and operating room technique.
Carl Lee Felt—2. Laryngology.

## HAHNEMANN HOSPITAL

*Tuesday, October 25*

H. L. Northrop—9. General surgery.
N. F. Lane and W. D. Culin—9. Gynecology.
F. H. Widman—2. Demonstration of the electrocardiograph.
C. Bartleit—2:30. Relation of electrocardiograph to operative surgery.
W. G. Schmidt—2:45. Hydrogen-ion concentration.
G. H. Wells—3:15. Acidosis.
J. S. Hepburn—3:30. Blood chemistry.
W. R. Williams—4. Application of blood chemistry to clinical surgery.

*Wednesday, October 26*

G. A. Van Lennep—9. General surgery.
J. E. James, Jr.—9. Prenatal care.
J. D. Elliott—2. Treatment of cancer with the knife and Coley's fluid.
H. L. Northrop—2:30. Treatment of cancer with electrothermic cautery.
F. C. Benson—3. Treatment of cancer with radium.
J. W. Frank—3:30. Treatment of cancer with X-rays; presentation of cases.

*Thursday, October 27*

H. P. Leopold—9. General surgery.
D. B. James—9. Gynecology.

*Friday, October 28*

L. T. Ashcraft—9. Urology.
W. C. Mercer—9. Obstetrics.
F. J. Frosch—2. Physiology and pathology of the endometrium.
S. W. Sappington—3. Basal metabolism, with demonstrations and technique.
J. D. Elliott—3:30. Tumors of the breast.
J. A. Brooke—4. Acute infectious arthritis.

## WOMAN'S MEDICAL COLLEGE

*Tuesday, October 25*

Alice W. Tallant—9. Obstetrics.
E. G. Alexander—10. General surgery.
H. C. Deaver—11. General surgery.

*Wednesday, October 26*

Ella B. Everitt—9. Gynecology.
Margaret Butler—2. Rhinology.
Mary Buchanan—3. Ophthalmology.

*Thursday, October 27*

Ella B. Everitt—9. Gynecology.

## CHILDREN'S HOMEOPATHIC HOSPITAL

*Tuesday, October 25*

H. P. Leopold—11. General surgery.

*Wednesday, October 26*

Bayard Knerr—11. Nose and throat.
F. W. Smith, Oscar Seeley, and O. F. Barthmaier—2. Pathological studies.

*Thursday, October 27*

John A. Brooke—2. Orthopedics.

## MOUNT SINAI HOSPITAL

*Tuesday, October 25*

J. C. Hirst—9. Gynecology.
George Rosenbaum—11. X-ray demonstrations.
A. Watson—2. Nose and throat operations.
C. W. LeFever—4. Eye operations.

*Wednesday, October 26*

M. Behrend—9. General surgery.
L. Fisher—2. Nose and throat operations.
A. I. Rubenstone—2. Surgical pathology and blood transfusion.
C. S. Hirsch—4. Genito-urinary surgery.

*Thursday, October 27*

L. Brinkman—9. Gynecology.
George Rosenbaum—11. X-ray demonstrations.

*Friday, October 28*

J. C. Hirst—9. Gynecology.
M. Behrend—11. General surgery.
L. Fisher—2. Nose and throat operations.
S. J. Gittelson—3. Eye operations.
A. I. Rubenstone—4. Surgical pathology and blood transfusion.

## WOMAN'S HOSPITAL

*Tuesday, October 25*

Mary Thomas Miller—9. Obstetrics.
Lydia Stewart Cogill—10. Obstetrics.
Ella Williams Grim—11. Obstetrics.
Ann Tomkins Gibson—12. Obstetrics.
Laura Emma Hunt—2. Nose, throat and ear.

*Wednesday, October 26*

Catherine MacFarlane—9. Gynecology.
Caroline M. Purnell—11. Gynecology.
Margaret Warlow—2. Nose, throat and ear.
Mary Getty—2. Eye.

*Thursday, October 27*

Marie K. Formad—9. Gynecology.
Sarah H. Lockrey—11. Gynecology.

*Friday, October 28*

Kate W. Baldwin—9. Spectro-chrome therapy or attuned color waves as an adjunct to general surgical work.

## WOMEN'S HOMEOPATHIC HOSPITAL

*Tuesday, October 25*

Drs. W. E. Strong, Rochester and Hartley—9. General surgery.
Drs. Palen, Clay and Criswell—2. Eye, ear, nose and throat.

*Wednesday, October 26*

L. T. Ashcraft—9. Urology.
W. C. Barker—2. Roentgenology.

*Friday, October 28*

Drs. Brooke and Larer—9. Orthopedics.
Drs. Caley, Hughes and D. B. James, Jr.—10:30. Gynecology.
J. A. Brooke—2. Obstetrics.

### ST. LUKE'S HOSPITAL

*Tuesday, October 25*

DESIDERIO ROMAN—9. General surgery.
O. F. BARTHMAIER and J. W. POST—2. Group study of the thyroid; laboratory, roentgenology, surgery.

*Friday, October 28*

DESIDERIO ROMAN—9. General surgery.
I. G. SHALLCROSS—11. Eye clinic.
J. W. POST—2. Roentgenological study of chronic arthritis as a basis for differential diagnosis and etiology.

### AMERICAN HOSPITAL FOR DISEASES OF THE STOMACH

*Thursday, October 27*

W. WAYNE BABCOCK—10. Gastric surgery.
LEWIS BRINTON—11. Clinical demonstrations of gastro-intestinal diseases.

*Friday, October 28*

J. B. CARNETT—9. General surgery.
FRANK WHITE—10. General surgery.
J. C. HIRST—11. Gynecology.

## SPECIAL CLINICAL DEMONSTRATIONS IN OPHTHALMOLOGY, OTOLOGY, RHINOLOGY AND LARYNGOLOGY

TO BE GIVEN EACH MORNING AT 9 O'CLOCK AT THE BELLEVUE-STRATFORD

*Tuesday, October 25*

JACOB P. SCHAEFFER, Philadelphia: Anatomy of the Lacrimo-nasal Apparatus—lantern demonstration.
Discussion by: HARRIS P. MOSHER, Boston; MEYER WIENER, St. Louis; JAMES A. BABBITT, WILLIAM C. POSEY, S. LEWIS ZIEGLER, Philadelphia; SIDNEY YANKAUER, New York.
CHEVALIER JACKSON, Philadelphia: Bronchoscopic Cases of General Surgical Interest—lantern demonstration.
Discussion by: FIELDING O. LEWIS, Philadelphia; ROBERT F. RIDPATH, Philadelphia; HARRIS P. MOSHER, Boston; HENRY L. LYNAH, CHARLES J. IMPERATORI, New York.

*Wednesday, October 26*

HENRY K. PANCOAST, Philadelphia: The Modern Treatment of Epithelioma of the Lip and Buccal Cavity.
Discussion by: GEORGE E. PFAHLER, DAVID R. BOWEN ALBERT G. MILLER, RALPH S. BROMER, WILLIAM S. NEWCOMET, WILLIAM L. CLARK, Philadelphia.
JOHN M. WHEELER, New York: Plastic Surgery of the Eye.
LEE COHEN, Baltimore: Corrective Rhinoplasty; Some Anatomico-Surgical Considerations.
WILLIAM W. CARTER, New York: Plastic Surgery of the Nose.
Discussion by: HUNTER W. SCARLETT, GEORGE N. DORRANCE, Philadelphia; GEORGE H. CROSS, Chester.

*Thursday, October 27*

THEODORE WEISENBURG, Philadelphia: The Relation of Intracranial Lesions to the Eye, Ear, Nose, and Throat.
LEWIS FISHER, Philadelphia: Intracranial Conditions as Localized by the Barany Test.
T. B. HOLLOWAY, Philadelphia: Ocular Findings in Intracranial Lesions.
WELLS P. EAGLETON, Newark, N. J.: Aural Manifestations of Intracranial Lesions.
Discussion: For Ear—B. ALEXANDER RANDALL, RALPH BUTLER, ROBERT J. HUNTER, GEORGE W. MACKENZIE, SETH A. BRUMM, Philadelphia. For Eye—WILLIAM ZENTMAYER, E. A. SHUMWAY, WILLIAM T. SHOEMAKER, Philadelphia.

*Friday, October 28*

JACOB P. SCHAEFFER, Philadelphia: Demonstration of Sinuses.
Discussion by: H. W. LOEB, Chicago; LOUIS A. COFFIN, New York; WILLIAM C. POSEY, Philadelphia; JOSEPH C. BECK, Chicago.
HARRY S. GRADLE, Chicago: Slit Lamp Demonstration.
Discussion by T. B. HOLLOWAY, Philadelphia.
GEORGE B. WOOD, Philadelphia: The Uses of the Galvano-Cautery in Diseases of the Larynx.
Discussion by GEORGE M. COATES, Philadelphia.

## PROGRAM FOR EVENING MEETINGS

In the Ballroom of the Bellevue-Stratford Hotel, at 8 p.m.

*Presidential Meeting, Monday, October 24*

Address of Welcome: George P. Muller, M.D., Philadelphia, Chairman, Committee on Arrangements.

Address of the retiring President: George E. Armstrong, M.D., Montreal.

Introduction of foreign guests: Sir Harold J. Stiles, K.B.E., Edinburgh; Sir William Taylor, K.B.E., C.B., Dublin; Sir William I. de Courcy Wheeler, F.R.C.S.I., Dublin; Sir Robert Hy Woods, F.R.C.S.I., Dublin; Professor H. C. Jacobaeus, Stockholm; J. Schoemaker, M.D., The Hague; Professor F. de Quervain, Berne.

John B. Deaver, M.D., Philadelphia: Inaugural Address.

Sir William I. de Courcy Wheeler, F.R.C.S.I., Dublin: Some Points about the Surgery of Bones and Joints.

William J. Mayo, M.D., Rochester, Minnesota: The John B. Murphy Oration on Surgery.

*Tuesday, October 25*

Symposium: Sarcoma of the Long Bones.

Joseph C. Bloodgood, M.D., Baltimore: Diagnosis and Pathology (illustrated).

William B. Coley, M.D., New York: Conservative Treatment.

Ernest A. Codman, M.D., Boston: Pathologic Fractures.

Henry W. Meyerding, M.D., Rochester, Minn.: A Study of Microscopically Proven Cases and End Results.

Discussion: A. P. C. Ashhurst, M.D., Philadelphia; Frederic A. Besley, M.D., Chicago.

Sir Harold J. Stiles, K.B.E., Edinburgh: Neuritis Due to Pressure of First Rib upon Brachial Portion of First Thoracic Nerve.

Professor H. C. Jacobaeus, Stockholm: Thorascopy and Its Practical Importance for Surgery of the Chest.

*Wednesday, October 26*

Symposium: Reconstruction Surgery.

Allen B. Kanavel, M.D., Chicago: Reconstruction Surgery of the Hand

Vilray P. Blair, M.D., St. Louis: Reconstruction Surgery of the Face.

Nathaniel Allison, M.D., St. Louis: Surgery of Impaired Joint Function.

Discussion: Robert H. Ivy, M.D., Philadelphia; A. Bruce Gill, M.D., Philadelphia.

J. Schoemaker, M.D., The Hague, Holland: Some Technical Points in Abdominal Surgery.

Symposium: Gynecology and Obstetrics.

Thomas S. Cullen, M.B., Baltimore: Abdominal Surgery.

John Osborn Polak, M.D., Brooklyn: The Present Status of Operative Obstetrics, Referring to the Abuse of Cæsarean Section.

Discussion: Brooke M. Anspach, M.D., Philadelphia; Edward P. Davis, M.D., Philadelphia; Barton Cooke Hirst, M.D., Philadelphia.

*Thursday, October 27*

Symposium: Gall-Bladder Surgery.

Harry M. Richter, M.D., Chicago: Gall-Bladder Surgery, with Special Reference to Closure of the Abdomen without Drainage.

George W. Crile, M.D., Cleveland: The Technique of Gall-Bladder Surgery in the Presence of Jaundice.

Discussion: Achille M. Willis, M.D., Richmond; George P. Muller, M.D., Philadelphia; John T. Bottomley, M.D., Boston; E. W. Archibald, M.D., Montreal.

Professor F. de Quervain, Berne, Switzerland: Relation Between the Histological Aspect and the Clinical and Epidemiological Peculiarities of Goiter.

Symposium: Nerve Suture.

Dean Lewis, M.D., Chicago: End Results.

Discussion: Charles H. Frazier, M.D., Philadelphia; G. Carl Huber, M.D., Ann Arbor.

*Convocation of the American College of Surgeons, Friday, October 28*

Invocation: D. Cardinal Dougherty, Archbishop of Philadelphia.
Conferring of Honorary Fellowships.
Presentation of Candidates for Fellowship.
Presidential Address: John B. Deaver, M.D., Philadelphia.
Fellowship Address: Sir Harold J. Stiles, K.B.E., Edinburgh.

The following distinguished South American surgeons are also expected to attend the Clinical Congress: Dr. Marcelino Herrera Vegas, Buenos Aires, Argentina; Dr. Claudio Sanjines, LaPaz, Bolivia; Dr. J. Alves de Lima, São Paulo, and Dr. Jose Mendonça, Rio de Janeiro, Brazil; Surgeon-General Alberto Adriasola, Valparaiso; Dr. Gregorio Amunategui and Dr. Lucas Sierra, Santiago, Chile; Dr. Miguel H. Alcivar, Guayaquil, Ecuador; Dr. Guillermo Gastañeta and Dr. Francisco Graña, Lima, Peru; Dr. Enrique Pouey, Montevideo, Uruguay.

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## PROGRAM FOR HOSPITAL DAY—MONDAY

In the Rose Garden at the Bellevue-Stratford

9:30 a.m. Hospital conference dealing with the standardization program of the American College of Surgeons including its present and future status. Representatives of the following organizations will participate: American Hospital Association, Catholic Hospital Association, Protestant Hospital Association, Methodist Hospital Association, Provincial Hospital Associations of Canada, Association of American Railway Surgeons, individual surgeons, superintendents and members of boards of trustees.

2:30 p.m. 1. "The Industrial Hospital," presented by two speakers followed by a general discussion.
2. The Nursing Problem: What Shall Be the Standard Regulations for Hospital Nurses? Shall There Be Lower Standards for the So-Called "Practical Nurse"? Shall There Be Supplementary Training for Nurses Desiring Administrative or Special Positions? These subjects to be discussed by a group of hospital superintendents, representatives of nursing organizations and surgeons.

4:00 p.m. Round table discussion: "What Constitutes Good Service to the Patient." Conducted by a group of hospital superintendents and staff surgeons.

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XXXIII NOVEMBER, 1921 NUMBER 5

# THE SURGICAL SIGNIFICANCE OF HEPATIC INCOMPETENCY[1]

BY WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE Great War brought to a close a period in scientific surgery, of which Dr. John B. Murphy was the most brilliant exponent. This period was characterized by the advancement of the principles of surgery, investigation of the relation of microorganisms to disease, and the development of clinical medicine on a pathological basis. Animal experimentation and the test tube marched side by side with clinical surgery and illumined many dark pages in our understanding of the phenomena of disease. The development of clinical surgery during the last generation was essentially regional, and in this development no one played so great a part as the distinguished man in whose honor this annual address is given.

Briefly to call attention to just what Murphy accomplished and the breadth and scope of his genius, we may cite his contributions to abdominal surgery for which he first became known. The Haymarket riots brought his name into prominence. While Bull preceded Murphy in the successful repair of gunshot wounds of the intestine, the brilliance of Murphy's performance gave vitality to Bull's exploit, and Murphy followed his operative work by promulgating the surgical principles governing gunshot wounds of the abdomen which guide us today. Murphy's early grasp of the appendicitis problem was equally firm and sure. His paper "Ileus," published in 1896, is one of the most valuable contributions to American surgery, and even today we fail to realize the importance of the parallel artery of the small intestine without corresponding veins which Murphy pointed out as a frequent cause of gangrene of the obstructed intestinal wall. We speak of "cutting off" the circulation in any part of the body when we usually mean the opposite. When the arterial circulation is cut off "white death" follows, a rare form of necrosis. "Black death" is the usual condition, the arteries continuing to carry blood into the involved gut, the obstructed venous flow choking the doomed area. Murphy also made valuable contributions to the study of tuberculosis of the peritoneum, pointing out that it is secondary to a local focus, and his genius was particularly manifest in clearing up moot points in the surgery of the biliary tract.

Murphy's mind, while never abandoning an accepted field of research, ever turned to new and unexplored regions of the body. His oration on "Thoracic Surgery," before the American Medical Association in 1898, brought out work of a fundamental character, showing the effect of the size of external pleural openings on collapse of the lungs, and that the diaphragm is essentially the piston of a thoracic pump. In surgery of the nervous system his contributions were equally important, stressing the fact that peripheral nerves divided proximal to the ganglion never regenerate and that a complete severance of the spinal cord due to injury is irreparable. In surgery of the vascular system, also, he

[1] The Second John B. Murphy Oration in Surgery, delivered before the Clinical Congress of American College of Surgeons, in Philadelphia, October 24–28, 1921.

dealt with fundamental problems and successfully sutured large vessels; his work in this field has been the basis of productive research. The more recent contributions which were made by him during the years immediately preceding his too early demise were in surgery of the bones and joints, where he greatly assisted orthopedic surgery to free itself from the shackles of the harness maker.

Other surgeons of Murphy's day and generation may be compared with him in various limited fields of surgical endeavor, but we must remember the number of targets into which he shot and that he always rang the bell.

Murphy was a voluminous writer and greatly enriched surgical literature. By these printed pages posterity will know him, but to those of us who have been inspired by his magnetic personality and who have, with rapt interest, followed his clinical teachings, visible evidences of the printed page are but the ghost hovering over the grave of the greatest surgeon of the last generation.

As the result of many causes, of which the profound influence of the Great War may be counted as one, we see, perhaps dimly, that surgery is taking on a new aspect. It is no longer possible for the individual surgeon, in the face of the enormous amount of new and, as yet, unorganized knowledge, to cover the ground that Murphy covered.

I knew Murphy well; his was not the nature that desired praise, but with the divine spark he desired ever to kindle new fires under old misconceptions. Therefore, in our annual memorial tribute to Murphy we should strive to emulate his standards and devote our endeavors to the advancement of the science of surgery, even as he devoted his life to this cause.

Our day of higher specialization and the correlation of the work of specialists in many fields is the foundation on which future progress depends. We see this exemplified in the study of shock in its relation to the nervous system as influencing operation, in the closer study of the heart, and the effect that changes in the vascular system may have on surgical conditions. We are beginning to recognize that although respiratory failure is the most frequent immediate cause of the termination of life, the material cause which produces the terminal pulmonary catastrophe is usually brought to the lungs through the blood stream, seldom by way of the respiratory passages, and that the influence of the anæsthetic is slight in producing postoperative pulmonary complications after surgical operations, which are equally frequent after local anæsthesia, nitrous oxide and oxygen, and ether. We are also gaining knowledge of the relation of the incompetence of the kidney to the cause of death. We have found that the kidneys do not secrete urine, but filter urine, and that with the urine are eliminated body waste and toxic products strained from the general circulation, that the kidneys are not often the primary cause of death, kidney failure being due to overload, and the development of acute conditions on pre-existing lesions. Studies of the blood have, therefore, become of the utmost importance because we recognize as never before that the toxic material which produces these wide-spread manifestations may affect more specifically certain of the vital organs. As shown by Rosenow, the bacteria and other toxic bodies are carried through the blood stream to the organs which they damage and lead to surgical complications and often to death. From this engrossing study has developed the modern doctrine of focal infections which is attracting the attention of present day investigators. The study of the methods by which purification of the blood is effected presents a promising field for investigation.

*The paramount importance of the hepatic function.* The liver was recognized, even by the ancients, as the king of organs, standing as a buffer on the one hand, between the general circulatory system and the gastro-intestinal tract, and, on the other hand, between the general circulation and the spleen, which filters from the blood micro-organisms and toxins that it is unable to destroy, sending them to the liver through the portal circulation for destruction and detoxication. The liver detoxicates chemic poisons, such as chloroform, phosphorus, and arsenic as well as biochemic poisons produced in the body. Yet, for many reasons, we know little concerning the functions or early pathologi-

cal conditions of the liver. Its concealed situation prevents us from accurate means from without of early diagnosis. Its power to regenerate injured cells and form new cells, is not equalled by any other organ of the body, and its enormous margin of safety prevents us from knowing just what is taking place in the earlier stages of hepatic disease, and the appalling nature of the pathological changes when they are sufficient to enable physical demonstration has made the liver an organ of mystery and conjecture. I venture to predict that the next few years will bring forth productive research demonstrating that the causes of many of the changes in the so-called vital organs which lead to death do not primarily originate in the nervous system, heart, lungs or kidneys, but are the results of hepatic insufficiency, leading to inefficient purification of the blood, thus making possible much sound prophylaxis.

I have, on a previous occasion, discussed the function and pathology of the liver in relation to the hepatic cell. All the liver cells are alike. Therefore, the pathological architecture in hepatic disease is simple. If the pathological process in the hepatic cell is acute the destructive process assumes the nature of fatty metamorphosis. If the process is chronic, the destroyed cells are replaced by connective tissue, producing cirrhosis. If the cause of the hepatic cirrhosis is carried to the liver by the portal circulation, the new connective-tissue deposit is around the portal vessels, obstructing the delivery of the blood from the portal circulation to the hepatic cells, and the patient does not die from hepatic insufficiency, but from the circulatory disturbances which lead to ascites and gastro-intestinal hæmorrhages caused by the portal cirrhosis. On the contrary, in biliary cirrhosis the causes of the injury to the hepatic cell are brought by the biliary channels, and the connective-tissue deposits are around the bile ducts, resulting in obstructions to the flow of bile, so that death occurs from cholæmia in cases of biliary cirrhosis.

In connection with hepatic cirrhoses, passing attention should be given to the work of Herrick, who shows the effect of the hepatic artery on the cirrhotic process. The pressure in the portal vein is 30 millimeters, and the pressure in the artery 130 millimeters. The greater the obstruction to the portal circulation the greater the circulatory embarrassment occasioned by the arterial counter-pressure. The slight amount of oxygen needed by the hepatic cell for its own purposes is furnished by the hepatic artery. It is interesting to note, in connection with carbohydrate metabolism, that in the liver of carnivorous animals the ligation of the hepatic artery may not cause serious effects, while in the herbivorous, it usually causes death.

*The liver acts on nonoxygenized blood.* The hepatic cell has an unrivalled capacity to act on portal blood, which has already lost its oxygen. The blood on which the liver acts is venous and leaves the liver as venous blood through the hepatic veins; oxygen plays little if any part in the changes which take place. Physiologists point out that the hepatic artery furnishes oxygen to the liver, and this would appear to be true, so far as the liver tissue is concerned, but the supply is not sufficient to lead us to believe that oxygen is necessary to its function. Compare the arterial blood supply of the liver, weighing 50 to 55 ounces, with the huge arterial blood supply of the spleen and kidney, each of which weighs only a few ounces, but uses a great amount of oxygen in functioning. The hepatic artery is not large and its content is reduced greatly by giving off the gastroduodenal artery, the superior pyloric artery, the supraduodenal branches, and the cystic artery; thus two-thirds of its volume are gone before it reaches the liver. How can we know the truth of this assertion that oxygen is not necessary for liver function? By proving an alibi: The arterial blood of the hepatic artery can not be in two places at the same time and most of it goes to other organs. Possibly one of the functions of the spleen is the removal of oxygen from the blood which enters the liver by this route. The functions of the liver are: (1) defense against invasion of the body by micro-organisms and the detoxication of toxic products brought to the liver from the portal circulation, (2) fat metabolism, (3) protein metabolism, (4) carbohydrate metabolism, and (5) bile function.

I cannot discuss here the fascinating problem of the effect of the liver on bacteria and toxic products of a chemic and biochemic nature. With regard to the effect of the liver on the final conversion of proteids into consumable material, I would point out that the amino-acids in the body are developed in the liver from protein metabolism begun in the intestinal tract. It may also be stated that the liver is one of the great store houses for fat, and the convertor of fat into consumable material for the use of the body. Urea is the ash of protein burning, and certain higher fatty acids, which may be a residue of improperly oxidized fats in combination with ash of improper proteid burning, are back of many of the circulatory and vascular changes which lead to insufficiency of the vital organs, especially of the kidneys.

*Sugar-forming function of the liver.* I regret that many aspects of these various problems, although germane to this discussion, must be omitted for lack of time. I shall concentrate attention on the relation of carbohydrate metabolism and bile function, on the liver, and on the organism as a whole.

The end stages of carbohydrate metabolism take place in the liver and the distribution of sugar for the heat and energy of the body takes place through the blood stream. The amount of sugar normally in the blood varies between 0.07 and 0.11 per cent. The ash of sugar oxidation in the tissues is passed out of the body through the lungs as carbon dioxide. Normally, considerable amounts of glycogen are stored in the liver and this store under great stress is fed more liberally into the blood stream, and in conjunction with the internal secretions gives the utmost obtainable energy under the influence of anger or fear, acting through the autonomic nervous system. In starvation the stored-up glycogen is exhausted and the alkalinity of the blood reduced, so-called acidosis. The pernicious vomiting of pregnancy is believed by Harding to be due to the exhaustion of the stored liver glycogen by the constitutional necessities of the mother and child; the treatment of pernicious vomiting of pregnancy by carbohydrate feeding appears to bear out this theory. As a rule reduction of sugar below 0.07 per cent is accompanied by dehydration. In the estimation of the blood sugar, which may appear to be normal because of the increased blood viscosity, allowance must be made for sufficient fluids to approximate normal conditions.

The ash of carbohydrate oxidation is much less poisonous than the ash of protein and fat combustion to which diabetic coma is due. As shown by Woodyatt, the proper burning of protein and the higher fatty acids is not complete unless a percentage of carbohydrates is burned in conjunction; hence the value of starvation in the management of diabetes by reducing fats and proteins as well as carbohydrates over the old treatment by carbohydrate deprivation alone. Attention must not be diverted from the fact that the hepatic cells are working on portal blood with very low oxygen content, herein differing from all other secretory organs of the body. Too little attention has been directed, I believe, to this nonoxygen feature of the function of the liver. Chronic bodily exhaustion is associated with disturbed function of the liver and usually with diminution of sugar metabolism. Mann has shown that if the liver of an animal is removed, death results in from 5 to 12 hours, but if the blood sugar is maintained the animal will live for from 24 to 35 hours, and even when apparently moribund can be resuscitated by intravenous injections of glucose.

*Function of the bile.* The hepatic lobule has for its center a bile channel. The venous blood from the portal circulation is acted on by the hepatic cell and passes away in the venous plexus of the collecting hepatic veins; the refuse, if it may be so called, takes it away to the intestinal tract in the form of bile. Nature is most economical in her operations. The bile in the intestinal tract has valuable direct and indirect functions, aiding in pancreatic and intestinal digestion. The fluids and certain constituents, such as the lipoids, are reabsorbed in the intestinal tract, while the bile pigments which contain the more active poisons of the biliary content pass and are excreted. It is interesting to note in this connection that the bile does not give the normal brown color to the stool, which may be

light and pasty without the addition of pancreatic juice. Physically the bile is changed after it leaves the hepatic cell. Additions are made to it from the biliary ducts and such bile as reaches the gall-gladder, as shown by Rous and McMasters, is concentrated and clear fluid added. If the bile is retained for any length of time in the gall-bladder by an obstructed cystic duct, the biliary pigments are absorbed and a clear colloid fluid, so-called white bile, results, as is also the case with bile in the ducts of the liver under similar conditions. The effects of retained bile pigments on the obstructed hepatic cell are most deleterious and destructive, the process being the familiar one of fatty metamorphosis, connective tissue taking the place of many of the destroyed cells, although new hepatic cells may be developed. Fitz has examined many specimens of bile from the gall-bladder under various conditions; the results of these chemical analyses were, on the whole, disappointing. When the bile is obstructed in its passage into the intestinal tract it is absorbed in the blood, the biliary pigments unite with the calcium in the blood, and, in the course of time, 3 weeks or more, a calcium exhaustion may occur. The reduction of the calcium reserve in the blood lengthens the coagulation time. The bile pigments, to which much of the ill effects of cholæmia are due, are excreted from the blood by the kidneys. The cholæmia not only affects the liver, but the tissues of the body as a whole. Cholæmia brings about a pernicious dehydration, interferes with the action of the liver, especially in its sugar-forming function, and exhausts the hepatic sugar reserve. The secondary effects of cholæmia are felt by every organ of the body, especially by the kidneys, which are called on to excrete a great amount of bile pigments and other products of disturbed metabolism which may result in kidney incompetency as well as liver insufficiency. In many respects the urine function of the kidney and the bile function of the liver are comparable. Especially is this true under stress. There is a close connection with diseases of the skin, liver, and kidneys, as though there were a correlation of function, notably the production of acute nephritis in the exanthemas and the poisonous bile of extensive burns of the skin which results in fatal duodenal ulceration.

### OVERCOMING THE EVILS OF CHOLÆMIA

The practical questions connected with cholæmia in its relation to surgery are obvious, and the successful solution of these problems carries lessons which can be applied to various other forms of hepatic incompetence. Bell and Walters, of the Clinic, have investigated cases of chronic jaundice in which operation had been performed for any and all conditions and death followed. Fifty-three per cent of these patients had blood in the peritoneal cavity, although not necessarily enough to account for the death. In comparable cases in which no jaundice was present there was only one instance of intraperitoneal hæmorrhage, which was caused by the slipping of a ligature on the cystic artery. In the jaundiced patients the blood in the peritoneal cavity was from capillary hæmorrhage; in no instance was the bleeding from demonstrable vessels.

Wright has pointed out that the loss of normal coagulation of the blood is due to calcium exhaustion and that the calcium can be restored by giving chloride of calcium by way of the gastro-intestinal tract. Lee and Vincent have shown that the amount of calcium that can be taken up from the gastro-intestinal tract is relatively small, but it may readily be given in the form of chloride of calcium intravenously in which form it affects the blood coagulation in a short time. Walters has been able to show that the coagulation time can be restored in from 2 to 6 hours after the intravenous injection of chloride of calcium and that the procedure is harmless. He repeated the experiments of other observers and it was not only shown that the administration of calcium promptly restored the blood coagulability due to calcium exhaustion, but that the coagulability of normal blood could be hastened in this manner.

In the cholæmic state, however, calcium may not be the only factor in the tendency to bleed, and when the calcium exhaustion has been remedied, if the coagulation time is still high, transfusion of blood is indicated. Two other factors of importance must be consid-

ered in counteracting the evil effects of the cholæmic state; first, to restore the normal amount of blood sugar and liver glycogen reserve, and second, to overcome the dehydration, and thus aid the kidney in the elimination of bile pigments, which are one of the chief causes of the general exhaustion of the cholæmic patient. Fortunately this can be accomplished by increasing the quantity of ingested carbohydrate and fluid intake, by mouth, by the Murphy drip, or if necessary, by subcutaneous infusions of from 3 to 5 per cent solution of glucose which can be introduced subcutaneously up to 2,000 or 3,000 cubic centimeters in 24 hours. The surgical indications are most safely met by great care and gentleness in handling the tissues of cholæmic patients during operation. No operative procedure which is not essential to the immediate recovery of the patient should be undertaken in the presence of intense jaundice. For example, after removing stones from the common duct in the cholæmic patient, cholecystectomy is seldom advisable.

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# THE TECHNIQUE OF GALL-BLADDER SURGERY IN THE PRESENCE OF JAUNDICE[1]

By GEORGE W. CRILE, M.D., F.A.C.S., Cleveland, Ohio

In jaundiced patients demanding operation, one prime risk is encountered, i.e., *exhaustion*.

The liver is a vital organ—as necessary to the maintenance of life as the brain or the heart. Excision of the liver is followed by an immediate functional and physical impairment of the brain cells, rapidly progressive to their complete breakdown with resultant death within from 2 to 12 hours. Moreover, any impairment in the integrity of the liver is accompanied by a corresponding impairment of the brain cells. Therefore, if as the result of obstruction of the common bile-duct, the liver has become engorged and distended with bile, and its function has become depressed, to a corresponding degree will the functioning power of the brain and other vital organs be reduced.

It follows that when operation is required in the presence of jaundice and depression, the failing resources of the patient, that is, the remnant of the liver function, must be scrupulously preserved; and, if possible, the margin of safety increased. In these cases the internal respiration is seriously impaired.

The prime requisite, therefore, to the conservation of the patient is the conservation of the internal respiration, especially the internal respiration of the liver cells and of the brain cells. The conservation of the internal respiration of the cells depends upon three primary factors: oxygenation, water, and neutralization of excessive acids.

All inhalation anæsthetics—even nitrous oxide—interfere with the internal respiration. In the case of nitrous oxide the interference with the internal respiration is but temporary—only during the period of administration. In the case of ether and chloroform, on the other hand, on account of their lipoid solvent effect upon the cell structure, their interference with the internal respiration is prolonged. The point of vital importance in this connection, and I believe the source of common error, is this: inhalation anæsthesia inflicts on the cells a definite functional damage. The mere fact that the patient comes out from under the influence of the anæsthetic does not eradicate the handicap produced by the anæsthetic. The inhalation anæsthetic deprives the patient of from 10, 20, 30, 50 to 100 per cent of his chance of ultimate recovery.

The internal respiration is depressed by cooling; it is promoted by heat. The continuous uncontrollable fall of the temperature of the brain following excision of the liver is equaled by the fall of the temperature of the brain during surgical anæsthesia under ether. Under nitrous oxide-oxygen anæsthesia the fall of the temperature of the brain is but slight, and under analgesia it is negligible.

It was the truth of these considerations, reluctantly accepted, that led me to substitute for deep inhalation anæsthesia, an extremely light form of nitrous oxide anæsthesia, namely, analgesia. Analgesia gives freedom from fear, worry, or anxiety; it mitigates the sense of pain about 80 per cent, and the balance can be covered by local anæsthesia. But the attribute of analgesia which is of vital importance to the patient is that it does not perceptibly interfere with the internal respiration.

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October, 24–28, 1921

As a result of the experience of the Great War, together with the findings of certain researches, an all-important principle has been introduced into the surgery of the bad-risk patient. The management and treatment is based on *probability* and not on the state of the patient at the moment. This conception is comparable to the principle of preventive medicine; that is, in the case of the bad risk patient we do *in advance of the emergency* all that we would do should the emergency develop. In preventive surgery as in preventive medicine, we can never know whether or not the preventive measures were required in the individual case; we only know that the emergency did not happen. Anociation, like asepsis, is an example of preventive medicine.

In cases of jaundice the failing vigor of the liver cells, and indirectly the vigor of the cells of other vital organs, is conserved and increased in accordance with the basic principles we have described above.

The function of the liver is depressed by narcotics, especially morphine. Therefore narcotics are contra-indicated in the presence of an already depressed liver function, both before and after operation. In these cases the damaging effects of emotion and of pain must be controlled as far as possible by management and by inflicting a minimum amount of trauma.

As stated above, cooling specifically depresses the liver function; therefore the exposure should be as slight and as brief as possible, and hot packs should be applied immediately after operation.

Blood transfusion promotes the oxygenation of the cells, and saline infusion aids in maintaining the water equilibrium and the acid alkali balance; therefore blood transfusion and large saline infusions should be employed either before or after operation. Their influence is not striking. No measure will produce a striking improvement; but a slight gain may establish the outcome, and the patient should have the benefit of even the small advantage which may mean the difference between life and death.

In grave cases, the operation should, if possible, be divided into two distinct physiological stages. The first stage should include only such measures as are required for the relief of the biliary obstruction, wholly disregarding any maneuver for the removal of the stones unless they are in the way. If the gall-bladder is distended, it should be drained by a fluid tight system, decompressing it slowly by intermittently unclamping the rubber drain.

The ultimate operation can well be delayed until the danger point is passed, and the stability of the liver cells and of the brain cells has become established.

As to the operative technique in jaundiced cases, we are committed to ample exposure, that is, to a long incision; but if the gall-bladder is distended, a short incision, for merely establishing drainage, may be all that is required, especially in aged patients with large gall-bladders which are easily defined prior to operation. A very short incision immediately over the gall-bladder for the insertion of the drainage tube may be so conducted as to become almost a minor operation. On the other hand, in broad-chested, fat patients, jaundiced as the result of obstruction from common duct stones, the Bevan or the Kocher incision may give a better exposure than a vertical right rectus.

In cases of common duct stones associated with chills, prostration, etc., in which the gall-bladder offers an avenue of temporary relief by drainage, the operation is divided into two parts, the first consisting of gall-bladder drainage only, followed later by a curative operation on the common duct.

If forced to operate in the midst of chills, prostration, etc., in a jaundiced case in which the gall-bladder is usually a shrunken mass of scar tissue containing no bile, while the common duct is dilated, the common duct is dealt with as follows: With a syringe, much of the bile is drawn off; in part to prevent contamination of the field when the duct is opened, in part to determine the kind of bile, the presence of pus, etc. The common duct is then opened and the stones in the immediate field removed, but no difficult and prolonged search is made, not even a prolonged effort to dislodge a stone in the duodenal part of the duct; but drainage—rubber tube drainage—sewed in to make a fluid tight connection with the common duct, completes

the technique. An abundance of drainage is placed around the point of common duct drainage and a generous portion of the incision in the abdominal wall is left open to ensure a safe drainage.

At the conclusion of an operation in which the entire biliary tract is not clearly defined and explored by the usual common and hepatic duct instrumentation, associated with the usual manipulation and palpation—that is, an operation completed without definite knowledge as to the number and location of stones—the surgeon has an uncomfortable feeling of suspended judgment, but he has his patient, who may be cured on another and more auspicious day.

*The postoperative treatment* has already been indicated. Briefly the main features are:

1. Hot packs over the entire liver region applied immediately after operation and continued intermittently until convalescence is securely established.

2. The subcutaneous injection of 3000 to 5000 cubic centimeters of water—repeated if required.

3. One or more transfusions of blood during the first week.

4. Avoidance of narcotics, especially morphine.

5. Intermittent drainage of bile. If it is noted that the bile is becoming more scanty in amount and paler in color the prognosis becomes correspondingly more grave. In my personal series of 629 operations on the gall-bladder and ducts, I have seen one case in which the bile was milky white in color. This patient died.

## SUMMARY

*Before operation* employ saline infusion, blood transfusion and heat.

*At operation* employ analgesia, local anæsthesia, means to maintain temperature of liver, decompression of bile, nothing more.

*After operation* employ blood transfusion; saline infusion, 3,000 to 4,000 cubic centimeters; application of heat to liver; intermittent drainage of bile.

*Avoid* deep inhalation anæsthesia, needless handling, morphine, doing too much. Decompress and no more.

An examination of the histories of 870 gall-bladder cases in the Lakeside Clinic shows the presence of jaundice noted in 389, or 44.7 per cent.

# FACIAL PARALYSIS

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FACIAL paralysis is a distressing condition which may be due to a number of very different causes. According to the nature and the site of the lesion, its outlook may be bright or gloomy. While the condition is present, it is always an unpleasant one. Of the associated symptoms one of the most weighty is the question of personal appearance. This consideration is universal in its appeal, and rightly so. Indeed, the psychic effect of the condition usually outweighs the physical. The patient is conscious that his appearance is not what it ought to be, and he is deprived of the power of expressing his personality by the modification of his facial muscles; his emotions are but half revealed, and he has always the feeling that the individua addressed regards him with a certain amount of pity or it may be of disparagement. Further, he is handicapped alongside his fellows in any activity, commercial or social, where personal appearance is of importance. Added to these the e are certain physical drawbacks. These group themselves naturally into those associated with the eye, t e brow, the mouth. Of oral disabilities, inability to control the lips permits of fluid escaping unless the head be tilted. The laxity of the cheek allows food to collect between the teeth and the lips. However, much he may wish to give expression to the *joie de vivre* he cannot do so by whistling, and in certain circles his prestige may be lowered by the inaccuracy of his aim in expectoration (20). Again, since it is impossible to control the lips accurately, the labial consonants cannot be formed with precision and clear enunciation is interfered with.

Inability to close the eye causes considerable discomfort in windy or dusty weather, while the lack of tone of the lower eyelid causes the puncta lacrimalis to point forward, hindering the drainage of the lacrimal secretion.

On all counts, therefore, one cannot but consider facial paralysis as a serious disability.

The actual gravity of the condition varies with the cause and the site. Interference with the nerve fibers corresponding to the face musculature anywhere between the lowest part of the motor cortex and their ultimate distribution will cause paralysis. Thus the upper neurone may be damaged by a cortical tumor or a cerebral hæmorrhage into the internal capsule. In such cases the facial paralysis would be but an incident in the main lesion. Usually lesions of the upper neurone are referred to as "cerebral" or "supranuclear" paralysis. Cases of this sort—seen typically in the hemiplegic—are characterized by the lower part of the face being chiefly affected. Lesions of the facial nucleus itself are usually spoken of as "nuclear" lesions, and of the nerve path below this level as "infranuclear" lesions. In nuclear and infranuclear lesions, the upper and lower parts of the face are as a rule equally involved.

The course of the nerve, though somewhat complicated, is such that it is comparatively easy to diagnose the exact part of it which is involved. The nucleus is situated in the pons, just external to the sixth nucleus. From here the fibers winding around the sixth nucleus, pass to the lower border of the pons, emerging with the eighth or acoustic nerve between the olive and the restiform body. From its exit from the pons to its entrance into the internal auditory meatus, the seventh and eighth nerves are intimately in contact. After entering the internal auditory meatus, the nerve traverses the aqueduct of Fallopius, having placed upon it the genicular ganglion and giving off the nerve to the stapedius as well as being joined by the chorda tympani carrying taste fibers from the anterior two-thirds of the tongue and secretory fibers to that region. From the petrous temporal bone the nerve emerges through the stylomastoid foramen, passes after a short course into the parotid gland, and after forming the pes anserinus breaks

up into several groups of branches. It is unnecessary for practical purposes to mention the facial muscles in detail. It should not be forgotten that the facial nerve is in reality a mixed nerve conveying not only motor fibers but sensory ones. The ganglion which is analogous to a posterior root ganglion is situated on the nerve a short distance after its entrance into the petrous bone. The sensory characteristics of the nerve need not detain us; they have been carefully studied by Ramsay Hunt.

A peripheral lesion may affect the nerve (a) at the nucleus, (b) between this and its emergence from the pons, (c) between this point and its entrance to the aqueduct, (d) in the aqueduct, (e) after separation of the chorda tympani to join the lingual. The vicinity of the sixth nucleus and nerve make it usually easy to locate a lesion in parts (a) and (b). In addition it is here usually associated with "crossed paralysis." In the third part of the course of the facial, the eighth nerve is frequently involved, and if the latter be not involved, paralysis of the fibers to the stapedius muscle produces the extreme sensitiveness to loud sounds known as "hyperacusis." In the aqueduct itself, involvement of the fibers of the chorda tympani produces loss of taste sensation in the anterior two-thirds of the tongue. A lesion of the fifth part of the nerve shows the typical complete motor paralysis (Bell's palsy); there is no interference with taste and no hyperacusis.

## ETIOLOGY

Among the causes of facial paralysis, the majority are well defined, a few are obscure. A supranuclear paralysis may be produced by a tumor, by an abscess, or by a cerebral hæmorrhage. An isolated nuclear paralysis is strongly suggestive of syphilis. In epidemics of poliomyelitis the cranial nerves may show involvement. Thus, in 338 cases at Queensboro hospital during the 1916 epidemic in New York, 46 showed involvement of the cranial nerves; of which 26 were of the facial nucleus and 12 of the sixth nucleus. Diphtheria may also be followed by facial paralysis. Cases of infranuclear paralysis are relatively more common. In the pons they are usually associated with tumor or hæmorrhage. Tumors of the cerebellopontine angle frequently involve both seventh and eighth nerves. Facial paralysis may appear as an incident in brain injuries. Of 195 cases of brain injury recorded by Sharpe, 3 showed facial paralysis. Two of them were associated with fracture of the skull. In both of these the paralysis was regarded as "due to a mild œdematous compression of the facial nerve at the usual site, the aqueduct of Fallopius." The third case was not associated with fracture of the skull. Steadily increasing intracranial tension was taken as an indication for decompression; at the operation the brain was observed to be "wet" and œdematous. The paralysis was of the cortical type and was regarded as due to "an acute cortical œdema following the injury; the almost immediate recovery from this facial weakness after the operation of decompression and drainage would also confirm the diagnosis of acute cortical œdema—at least of the left cerebral cortex."

The three commonest causes of facial paralysis, however, are those which affect the nerve in the outer part of the facial canal or after its emergence from the skull. These are:

1. A simple neuritis commonly the result of exposure to cold, especially when the patient has become heated from exertion. Thus one patient, after a strenuous day of golf in the heat of summer, drove several miles in an open car in the cool of the evening and awoke next morning with a unilateral facial paralysis.

2. Spontaneous occurrence is possible in the course of acute or chronic otitis media; this is more marked in children. This matter is discussed by Barton Jones, who regards facial paralysis in connection with otitis media as of infrequent occurrence. When it does occur it is brought about either by direct involvement of the nerve or by pressure of exudation within the fallopian aqueduct or by pressure from the tympanum. Caries of the wall may take place even in the acute stage. The facial nerve has sometimes been found postmortem lying free in the tympanic

cavity surrounded by pus, and yet no symptoms of facial paralysis may have been observed during life. From this he concludes that it might reasonably be inferred that to produce facial paralysis pressure must be applied to the nerve while the latter is confined within its narrow bony tunnel. The paralysis may come on suddenly or gradually; certain muscles may be affected more than others, severe pain may precede its development, or muscular twitchings may occur.

3. Traumatism, surgical or otherwise, may produce facial paralysis. In the complete mastoid operation, the breaking down of the "bridge of bone" between the antrum and the middle ear is a possible source of danger to the facial nerve. The great majority of cases come from this source. In children, owing to the small development of the mastoid process, the facial nerve is almost superficial, and special care is necessary even in such a simple operation as drainage of the antrum. Again in children systematic and thorough removal of enlarged glands of the neck is fraught with danger. One of my cases showed no obvious cause for the condition. It was probably due to a sclerosing process about the internal auditory meatus involving both seventh and eighth nerves. Another case was inevitable as a result of extirpation of the cochlea. Still another case was the result of a rifle bullet wound which severed the facial nerve cleanly just after its exit from the stylomastoid foramen.

Bilateral facial paralysis is not a very common condition. De Castro maintained that of such cases, 95 per cent are of syphilitic origin. This, however, is not generally accepted. Askgaard quotes a case where syphilis was to his mind out of the question, and is strongly of the opinion that in most cases the origin is "rheumatic." He is no more prepared, however, than anyone else to fix a precise connotation for the word "rheumatic."

PROGNOSIS

The prognosis depends essentially upon the site of the lesion and its character. Cases affecting the upper neurone are not likely to show spontaneous recovery. The majority of cases of facial paralysis met with do clear up, because the bulk of them are cases of simple neuritis associated with exposure. In the case of injury to the nerve resulting from operation, no recovery is to be looked for if there has been actual severance of the nerve fibers, and it is hard to see how recovery can take place, where paralysis is a sequel to operation, except in the cases where a localized œdema of the nerve is a result of reactive processes in the neighborhood. Outside the skull, the prognosis is not so good. The nerve very soon breaks up into branches, and judging from one's experience in nerve suture, the outlook is rather unfavorable when a large number of branches pass off near the point of damage. Broadly speaking, therefore, it may be said that when paralysis comes on suddenly and completely after a mastoid operation and does not clear up in 5 or 6 weeks, there is not likely to be spontaneous recovery. It is of some value in all cases to test the electrical reactions. In cases of complete severance the reaction of degeneration appears in about 2 weeks. The presence of a response to faradism is always a hopeful sign. Those who have a good deal to do with electrical reactions in nerve lesions incline to place less stress upon mere qualitative response. Without a condenser to give quantitative measurements, electrical tests are of limited value, and the condenser is an instrument not always available.

TREATMENT

This depends upon the cause. Where the facial paralysis is but an incident in a more serious affection, as in hemiplegia, one's conduct of the case must be governed by general considerations. The only case of facial paralysis in poliomyelitis which I have observed made a spontaneous recovery in regard to the facial nucleus in about 6 weeks. Cases of facial neuritis (Bell's palsy) generally recover in a time varying from a few days to a few months. We are accustomed to treat these cases by massage of the facial muscles and by galvanism. It is doubtful if these measures are of much value. They are of some psychic use at least, comforting surgeon and patient alike with the feeling that "something is being done."

The large group of cases where facial paralysis, complete and permanent, is the main entity deserve special consideration. Where this follows directly upon operation for mastoid disease, there is a double demand from patient and operator that an effort be made to remedy the defect. The otologist is usually distressed, this being as a rule the only case he has ever had in a vast experience of the operation, and the liveliness of the patient's gratitude for relief from the ear condition is much diminished by the prospect of going through life with one side of his face an immobile mask.

One always feels in such cases that an attempt to improve the condition is a pressing surgical duty. The stake the patient lays is not a very heavy one; even if he loses it and gains nothing, he is not a very heavy loser, while if he does gain, the gain is considerable.

Operative methods fall into two groups: (a) those which assume the nerve defect to be irremediable and attempt by transplantation of muscle, fascia, etc., to remedy the main disadvantages due to defective musculature; and (b) those which attempt to innervate all the facial muscles by means of nerve anastomosis.

Before discussing the relative merits of these two points of view it is well to remind ourselves of the main effects of facial paralysis. The facial muscles may be grouped in three sets: (1) those which act upon the angle of the mouth, especially those which elevate it; (2) those which act upon the eyelids, especially the lower, elevating the latter and thus assisting in closure of the eye; (3) those which act upon the forehead, enabling the brow to be wrinkled and the eyebrow raised. All of these actions are not of equal value, nor are they equally valued by all patients. On the average we might place the elevation of the angle of the mouth at 50 per cent to 60 per cent, the elevation of the lower eyelid at about 30 per cent to 40 per cent, and the action on the forehead and eyebrow as not more than 10 per cent.

The plastic operations which are performed have, as one would expect, two designs, (a) to elevate the lower eyelid; and (b) to elevate the angle of the mouth. Elevation of the lower eyelid may be attempted by raising a pedunculated flap from the temporal muscle anterior border. This is sutured along the lower lid to the orbicularis palpebrarum (Lexer). Efforts to raise the angle of the mouth have also been made by a strip of free fascia (Stein), by a graft from the masseter or the sternomastoid, (Jianu) or by the insertion of aluminum-bronze wire so as to sling the upper lip from the zygomatic arch (Busch Momberg).

Published reports indicate that there may be a place in surgery for operations with such an aim, but if by nerve anastomosis a prospect is afforded of more equal innervation of muscles, such an operation has a logical priority. The plastic operation involves a scar which is apt to be clearly visible. Speaking without any experience of any of them, one feels that they are more ingenious than trustworthy. The further criticism is applicable that they are more suitable when one branch of the facial nerve has been injured or after an attempt at nerve anastomosis has definitely failed.

Study of the literature would convey the impression that there remains very little more to be said to convince the surgeon of the practical utility of the operation of nerve anastomosis. Information on the subject is not yet, however, universally shared, as would appear from a recent publication (1919) "prepared at the suggestion of the Subsection on Plastic and Oral Surgery connected with the office of the Surgeon-General." It says: "When the facial nerve has been divided external to its exit from the petrous bone, causing facial paralysis, anastomosis with the central end of the spiral (?) accessory nerve or the hypoglossal nerve is an approved operation. Such anastomosis, however, is impracticable if the injury to the facial nerve has occurred within the aqueduct of the petrous bone." In the succeeding paragraph the suggestion is made that "Perhaps a nerve graft from sciatic nerve might be used to repair facial nerve." (What would happen to an undergraduate who put that sort of thing in an examination paper?)

A new impetus has been given to the subject of nerve anastomosis by the enormous number

of cases of nerve suture resulting from the war. Personal experience of nearly two hundred cases of nerve suture, although it has not enabled one to speak with confidence regarding the result in any individual case, justifies the opinion that provided careful end-to-end anastomosis is obtained without tension, the majority of cases will give at least some recovery of function. The ingenious methods of lateral implantation and of nerve grafting have been clinically uniform failures; the two points mentioned are the essentials—neat apposition and no tension. It is possible to obtain these requisites in the case of the facial nerve. In moderately close proximity are found the hypoglossal and the spinal accessory, and each of these is fairly similar in size to the facial nerve.

In 1903, Ballance recorded his experience up to date. His first case was done in 1895, the spinal accessory being cut half through and the facial sutured into the cleft with fine silk.

In 1898, Faure united the trunk of the facial nerve to the trapezius branch of the spinal accessory by end-to-end suture. The result was not good. In 1899, Kennedy performed end-to-side anastomosis of the facial and accessory for facial spasm. In 1900, Manasse reported a case in which he did an end-to-side anastomosis between facial and accessory. In 1901, a similar case was put on record by Barrago-Ciarella. By 1903 Ballance was able to report that 5 patients out of 6 showed voluntary movement, the previous paralysis having lasted from 5 months to 3 years. He further claimed that after operation facial muscles which had shown contracture immediately became flaccid again, and that tonus returned rapidly to the muscles so that at rest the face became symmetrical. Motor power was also observed to return before faradic excitability. There was, however, in no case independent movement of the face unassociated with shoulder movement. He was prepared to recommend in future faciohypoglossal anastomosis. The first actual faciohypoglossal anastomosis was performed by Koerte in 1901. The first patient so operated on by Ballance was treated in 1902. In 1903, Harvey Cushing recorded a case of facio-accessory anastomosis similar to those of Ballance. Practically the same degree of success which he had attained was reached by Cushing's patient. In 1903, also Frazier and Spiller published a "preliminary report on one case." This was a faciohypoglossal anastomosis in a case of gunshot wound with complete paralysis. They recognized three stages of improvement: (1) restoration of normal muscle tone which in itself would warrant the operation; (2) voluntary control over individual muscles; (3) complete and perfect recovery, i.e., the return of expressional movements, etc. They concluded that the first can ordinarily be expected, the second is "liable to follow," the third would be more likely the younger the patient. In 1908, a number of cases were put on record. Girard reported 4 cases of facio-accessory anastomosis; Knapp, 3 cases of faciohypoglossal anastomosis; Currie reported from South Africa a case of anastomosis between the seventh and eleventh nerves. Halstead proposed the modification of reflecting the mastoid process along with the origin of the sternomastoid, a procedure which is sometimes of use to give a larger field for tracing the facial nerve to the stylomastoid foramen. In 1909 Ballance again contributed a paper on the subject. He described a case in which after anastomosing the facial to the hypoglossal he joined the distal segment of the twelfth nerve to the eleventh. He showed the case at the German society of surgeons in Berlin, and at the same meeting Tilmann, of Cologne, showed "a very successful case of faciohypoglossal anastomosis" 4 years after operation. Ballance summed up strongly in favor of the twelfth as against the eleventh nerve for use in anastomosis. "Experience has shown that the atrophy of one-half of the tongue leads to no material inconvenience, but loss of power in sternomastoid and trapezius muscles may be associated with deformity, discomfort, inconvenience and even worse results." He further claimed that "the movements" in his case "due to emotional stimuli are symmetrical and perfect." This is an unusually good result. In 1909, also a paper appeared by Beck giving a very good résumé of the litera-

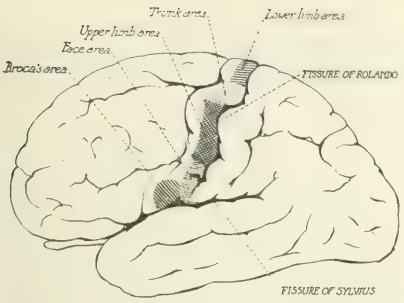


Fig. 1. Cerebral cortex showing motor areas and speech center. (Modified from Cunningham.)

ture up to date, and an account of 5 cases operated upon by himself by faciohypoglossal anastomosis with promising results. He emphasized the large number of cases which result from suppurative otitis or trauma of the nerve in operations on the temporal bone. In this year also, Alt, of Vienna, described a method of opening the facial canal directly, blanching the tissues with adrenalin as he went, and relieving compression on the nerve. As far as can be made out, this method has not been developed any further. An interesting case was reported by Grant in 1910. The patient suffered from a pistol wound of the right ear. Grant stitched the facial to the accessory, and then united to the stump of the accessory the descendens hypoglossi. Six months later the patient could play the flute. In commenting on the case he says: "The descendens hypoglossi is a little smaller than the accessory but that is not an important objection. The accessory is a little smaller than the facial but that is no disadvanage in facial anastomosis." In 1911, a paper appeared by Rothschild, reviewing 188 reports on the subject and giving details of 68 cases, 10 from American literature. The remote results were given in 46 cases. Of these 8 cases showed "complete restitution," the majority of the results were fair, and only one case was a complete failure. With this rosy pronouncement it is of interest to learn from the paper of Zesas in 1914, that in 73 cases of chronic facial paralysis which he had compiled and which had submitted to nerve

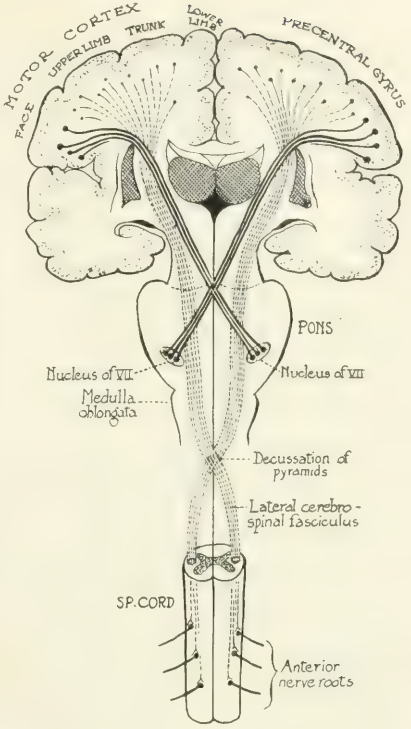


Fig. 2. Diagram of relations of upper facial neurone. (Modified from Gray.)

anastomosis, the results were disappointing; no benefit was received in over half the cases. Even in cases regarded as successful, the improvement was meagre, and there were numerous annoying by-effects. He thought much better results were to be obtained by plastic operation on muscles such as those of Gomoiu and Jianu, of Lexer and Hildebrand. He then described the technique of Busch's wire-loop and Stein's fascia-flap methods. One cannot but think that Zesas when he studied the subject of nerve anastomosis was not in a judicial frame of mind.

It is unnecessary to pursue in detail the later reports on the subject. Nothing sub-

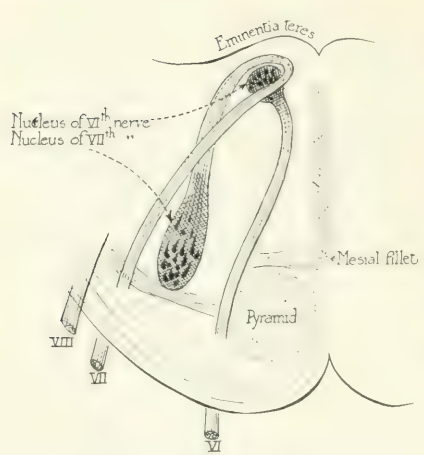


Fig. 3. Diagram to show relation of facial nerve to sixth and eighth. Region of pons. (Modified from Cunningham.)

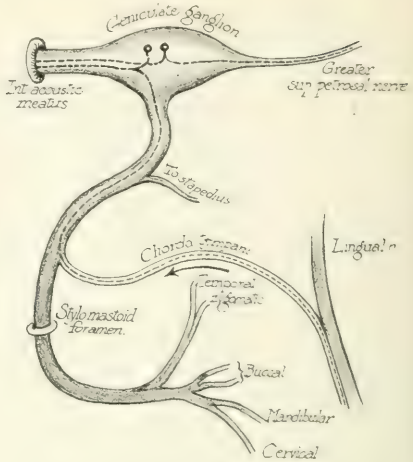


Fig. 4. Diagram showing essentials of intrapetrous part of facial nerve. (Modified from Gray.)

stantially new has been added by recent writers. With the increasing specialization in surgical work, it is not always an easy matter to determine into which specialty any given subject falls. Faciohypoglossal anastomosis is one of these "bones of contention." The general surgeon claims it as he claims everything as his province that requires the use of a scalpel and some things that do not. The otologist claims it. Very often he has a better right to it than anyone else, though not always on the ground that it requires more delicate handling than the general surgeon is prepared to give it (Beck). The neurological surgeon claims it inasmuch as it involves the peripheral nerves, and are they not part of his territory? The orthopedic surgeon claims it inasmuch as nerve suture in military surgery was by common consent handed over to him, and if one has had much experience in the suture of the noncranial nerves, why not apply that experience to the cranial nerves? Besides no one will deny that facial paralysis is a serious deformity. It does not matter from the patient's point of view whether the operator is a general surgeon or a specialist. What does matter is that the operator should know his anatomy, and should be able to handle delicate things delicately.

### OPERATION FOR ANASTOMOSIS OF FACIAL AND HYPOGLOSSAL NERVES

An incision is made from well up on the mastoid process down to the greater cornu of the hyoid bone. This incision can be readily made in one of the natural lines of flexure of the neck and after the lapse of a few months is well-nigh invisible. The platysma is cut through, and the interval between the sternomastoid muscle and the parotid gland is thoroughly opened up. A few strands of fibrous tissue are usually encountered and occasionally a twig from the facial nerve may be found. The nerve itself lies somewhat deeply, a good inch from the surface of the skin, and generally about the level of the tip of the lobule of the ear. Its direction is in general transverse. It is important to avoid if possible opening the capsule of the parotid for the lobules of the gland tend to obscure the view and there is added oozing. This stage of the operation is at times difficult. There has usually been some removal of the

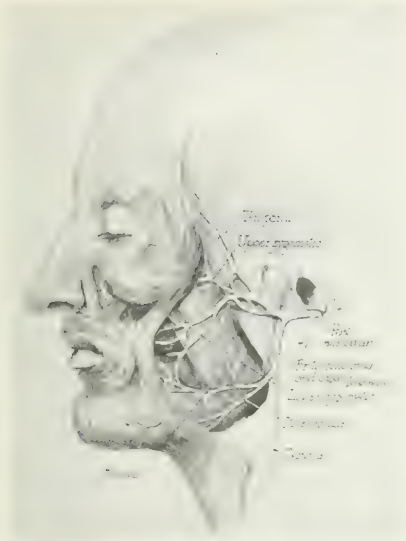

Fig. 5. The facial nerve—distribution on the face. (Modified from Cunningham.)

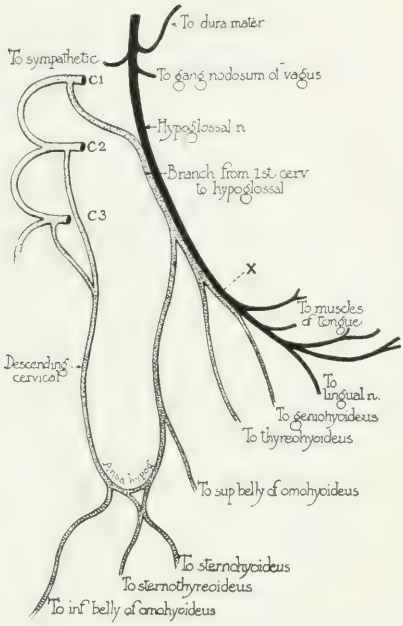


Fig. 6. The hypoglossal nerve — showing distribution, relation to cervical plexus, and *x*, the point of section in seventh and twelfth anastomosis. (Modified from Gray.)

mastoid process, and the scar tissue keeps on oozing so that the field of operation is kept clean with some trouble. If there has been degeneration of the nerve, its pinkish color renders it difficult to recognize, and its soft consistency makes injury easy. It also seems to stain somewhat with the oozing blood, and because of this it is not always easy to distinguish. Indeed, it usually occurs that the nerve has been in the field of operation for a short time before it is clearly identified. Next comes the process of isolating it up to the stylomastoid foramen. This may be difficult. The posterior auricular artery which runs along the upper border of the posterior belly of the digastric muscle, seems to send off numerous fine twigs which are always ready to shed a few corpuscles in the field, and there are equally numerous venous radicles assisting in the process. Again the nerve passes in to the deep surface of the mastoid process and it may be necessary to remove the tip of this prominence in order to make the exposure complete, as was done by Halstead.

Section of the nerve is then made at the stylomastoid foramen. As this is done, there is usually a small spurt from the stylomastoid branch of the posterior auricular artery. In the remaining steps of the operation one of several methods may be followed. The hypoglossal nerve may be isolated and divided, and then the distal end of the proximal segment brought up to meet the facial by tunnelling through the soft parts. This is apt to put some strain on the hypoglossal, and it is probably better to isolate the nerve so that there is a distinct sulcus in the upper part of the neck, the floor of which is occupied by the posterior belly of the digastric. This entails dealing with a number of veins notably the common facial vein and some of its smaller

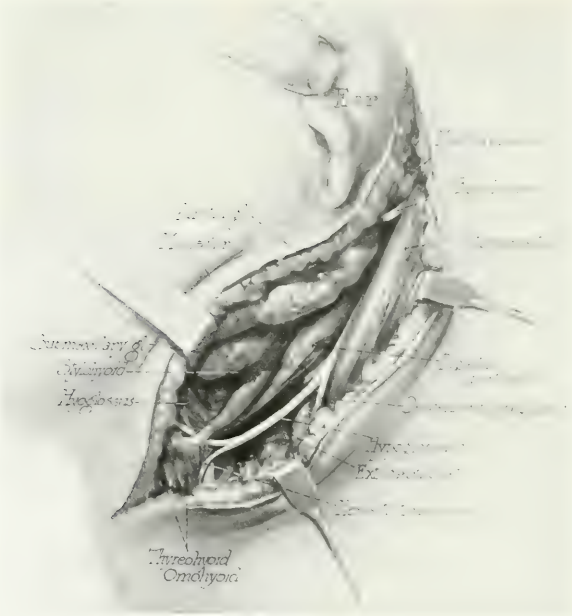


Fig. 7. Diagram showing essentials exposed in defining facial and hypoglossal nerves.

tributaries. The posterior belly of the digastric is the key to the region. Under cover of its upper border, far forward, the hypoglossal nerve is seen emerging to course superficial to the hyoglossus muscle; traced backward toward its origin, it will be noticed to give off the descendens hypoglossi to run downwards in close relation to the external carotid artery, carrying from the first cervical nerve, fibers to join with fibers from the second and third cervical nerves in the ansa hypoglossi from which a nerve supply passes to the infrahyoid muscles. The nerve to the thyrohyoid muscle is seen coming off as a separate branch and has to be sacrificed. It is usually possible to conserve the descendens hypoglossi. Soon after the hypoglossal nerve has come into relation with the hyoglossus muscle it is seen to break up into a leash of branches, which go to supply the geniohyoid (first cervical fibers), the genioglossus, and the intrinsic muscles of the tongue. The hypoglossal nerve is cut off just proximal to its division into numerous branches and is then amply long enough to permit of its being brought in contact with the proximal extremity of the distal segment of the facial without tension. When the anastomosis has been made it will be found to lie over the posterior belly of the digastric. The method of making the junction is a matter of choice. It is possible and desirable to make the union by stitching together the sheaths of the nerves without injuring more than is necessary the nerve fibers themselves. For this purpose the finest needles with non-cutting edge are employed, and as a result of experience, one is inclined to use fine silk. On the last occasion on which this operation was performed, I procured some of the finest Chinese twist silk and found it to consist of three strands. These were unwound and used as three

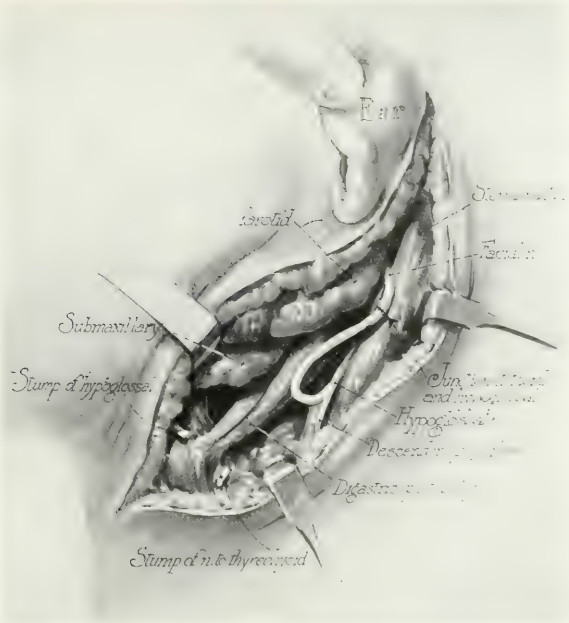


Fig. 8. Diagram showing anastomosis of facial and hypoglossal nerves.

separate sutures. As there is no tension on the sutures after they are tied, one is able to gauge the degree of strain which it is possible to employ. In using even the finest catgut, one is conscious of a lack of flexibility, which is apt to bruise the nerve. This is not the case in employing silk. Moreover, the experimental work of Sargent and Greenfield shows that fine silk is less irritating than plain catgut, although it is unabsorbable. No special bed is prepared for the junction. Deeply, it rests on the posterior belly of the digastric, while it is covered by the fatty tissues of the upper part of the neck. Hæmostasis is made very carefully; a drain may or not be put in according to whether one is satisfied or not with the dryness of the wound. For making the skin suture one may use silkworm gut, horsehair, or silk as it pleases the operator.

The operation is in no sense a dramatic one; it is apt to be tedious, and delicate handling is very necessary at all times. The nerves themselves are of small diameter, and the facial may be distinctly soft and friable, so that only the most gentle manipulation is permissible.

### ILLUSTRATIVE CASES

Case 1. Pte. W.H.C., age 27. In August, 1918, he had radical operation for cure of mastoid disease. Facial paralysis followed immediately on operation and was complete. At the request of the operator concerned, I performed faciohypoglossal anastomosis on November 29, 1918. Incision was made from the mastoid down to the hyoid bone. Branches of the facial nerve were secured and followed up to the stylomastoid foramen. The hypoglossal nerve was then isolated up to the point where it was breaking into branches. Ends were brought neatly together with No. 00 catgut, three sutures. Skin was sutured with silkworm gut. No drainage.

Fig. 9. Case 1. W. H. C. March, 1921. At left, face in repose; center, showing movement; at right, showing tongue—note furrow.

This patient was under treatment with massage and galvanism for 6 months. He was then discharged from the army, and was not seen again by me until February 18, 1921. Examination on this date showed very considerable improvement. With the face in repose it was difficult to tell which was the paralyzed side. There was no drooping of the angle of the mouth and the palpebral fissure on the affected side was no more widely open than on the sound side. Voluntary movement was present everywhere except in the frontal region. The patient was unable to whistle. The electrical reactions of the muscles were tested and all including the outer fibers of the frontalis reacted to faradism. It was very beautiful to see the contraction of the tiny procerus (pyramidalis nasi) and nasalis (compressor naris). The tongue was remodelled so that it appeared as median mass with a deep furrow along the right side. Patient eats almost entirely with the sound side as he has not yet sufficiently great control to prevent the food lodging between the cheek and gum on the affected side. Emotional use of the facial muscles is confined to the unaffected side.

Case 2. J. S., age 36, chartered accountant. This patient was seen by me for the first time on December 5, 1918. He complained of right-sided facial paralysis. Onset was gradual about 7 years previously. The cause was quite unknown to him. During the last 4 years the paralysis had become very much more marked. He had had no operation and no history of suppuration in the middle ear. On examination there was found a complete facial paralysis of the right side. Taste was tested and inaccurate response was given for the anterior two-thirds of the tongue on the right side (Chorda tympani). The atrophy of the facial muscles was very pronounced. He had practically no hearing in the right ear. There was no paralysis of the soft palate and no atrophy of the tongue. Knee-jerks were present and were not exaggerated. Electrical reactions of the facial muscles showed no reaction to faradism, and a very feeble reaction to galvanism. Cathodal closure contraction was stated to be slightly greater than anodal closure contraction. Specialist's report on the ear condition was as follows:

"Examination of Mr. J. S. shows otitis media catarrhalis chronica in both ears, worse in the right ear with involvement of the seventh and eighth nerves in right ear. Lesion of both nerves probably in the internal meatus. Would advise radiograph of the mastoid bones."

Radiographic examination like the report of the ear specialist added nothing to our previous knowledge. A Wassermann test of the blood proved negative.

On January 13, 1919, operation was performed. The facial nerve was identified and traced up to the stylomastoid foramen where it was severed. It presented no very obvious abnormality. The hypoglossal nerve was isolated in the neck, the branch to the thyrohyoid was sacrificed, and a junction made between the facial and hypoglossal nerves by three sutures of No. 00 catgut. As there was considerable oozing a drainage tube was inserted for 24 hours. The stitches were removed in a week, and shortly thereafter massage and galvanism were commenced. These were continued for 6 months. Voluntary power was noticed first of all in the

Fig. 10. Case 2. J. S. At left, taken July, 1918, showing condition before operation; center, face in repose; at right, attempt to smile. Center and right photographs taken November, 1920.

muscles about the eye on November 26, 1919. On February 6, 1920, it was noted that voluntary power was present in all the muscles of the right side of the face. Patient spent a considerable part of the year in England, and on October 22, 1920, on the first visit after his return, a note was made to the effect that "the improvement is very remarkable. The brow on the right side can be raised fairly strongly, and the right eye can be almost closed. Action of the muscles around the mouth is also extremely good. In repose it is almost impossible to tell that there is any paralysis."

Case 3. Pte. L. B., age 35, sustained a gunshot wound of the head on August 9, 1918. Facial paralysis was immediate and complete. The bullet passed from just in front of the left auricle to the middle line of the neck posteriorly. On March 21, 1919, the facial nerve was exposed and found "somewhat atrophied and degenerated." The hypoglossal nerve was then isolated and the branch to the thyrohyoid was cut through. The seventh and twelfth nerves were then joined by No. 00 catgut, three sutures. As oozing had been considerable, a rubber drainage tube was put in for 24 hours. The skin was sutured with silkworm gut. Shortly after this the patient received his discharge from the army, and was not again seen by me until February 18, 1921. Voluntary movement was then present in all muscles of the left side of the face including the frontalis. The platysma was acting quite strongly. Patient could close the left eye completely and was able to whistle quite well. A reaction to faradism was obtained in all the muscles of the left side of the face. The tongue was protruded

Fig. 11. Case 3. L. B. March, 1921. At left, face in repose; center, in movement; at right, showing tongue.

Fig. 12. Case 4. J. C M. April, 1920. At left, face in repose; center, in movement; at right, showing scar.

Fig. 13. Case 5. E. E. February, 1921. At left, face in repose; center, in movement; at right, showing scar.

straight and no difficulty was observable in articulation of labial or lingual consonants.

Case 4. Cpl. J. C. McV. had operation done for radical cure of mastoid infection in August, 1918. This was followed by immediate and complete paralysis of the right side of the face. At the request of the otologist, anastomosis of facial and hypoglossal was performed on April 4, 1919. The operation proved somewhat difficult. The landmarks were somewhat obscure, the greater part of the mastoid process having been removed. The scar tissue was extremely troublesome from constant oozing, and in addition, there was a number of enlarged lymphatic glands with a good deal of matting around them. The facial nerve, however, was isolated and cut across above its division into cervical and temporal branches. Junction between seventh and twelfth nerves was carried out with four No. 00 catgut sutures. The skin was sutured with silkworm gut. For this patient an appliance was made with a view to keeping the facial muscles relaxed. It consisted of a small metal flange hooking into the labial commissure with a metal ear hook. The outside of the oral flange was painted flesh-color. The apparatus appeared to present no advantages over a cigarette mouthpiece, and was lacking in some of the potentialities of the latter. Frazier has used a strip of flesh-colored adhesive, drawing the angle of the mouth upwards toward the ear. A report on this patient was made on April 6, 1920: "Voluntary power was present in the lower part of the face, but no voluntary power in the muscles above the eye." A photograph was taken on April 10, 1920.

Case 5. Pte. E. E., age 49. This patient was seen by me for the first time on April 14, 1919. His history was that in the beginning of March, 1919, he had had a left mastoid operation. Facial paralysis was immediate and complete. It was decided to see if any improvement could be brought about by massage and electricity. This was persevered with until August, 1919, but no return of function occurred.

On August 25, 1919, anastomosis of facial and hypoglossal was carried out. It was noted that the facial nerve was somewhat pink and had the usual appearance of a degenerated nerve. Three No. 00 catgut sutures were used. A tube was left in for drainage for 48 hours. Skin was sutured with silkworm gut. Treatment with massage and galvanism was instituted and was kept up for 12 months. On August 30, 1920, it was noted that distinct voluntary movement was present in practically all the muscles of the face. The transverse lines of the forehead were well marked and the nasolabial fold was clearly seen. Treatment was stopped at this time.

Fig. 14. Case 6. E. L. J. February, 1921. At left, before operation; center, face in repose; at right, the scar.

He reported again on November 25, 1920, and at this time voluntary movement did not appear to be so good as at the last time of reporting.

Patient was again examined on March 3, 1921. Voluntary movement was present in all the muscles of the face, and all reacted to faradism. Patient cannot whistle. The right eye cannot be closed independently of the left eye. The flexure lines of the face are particularly well marked in this patient and the wrinkles on the right side of the brow are well seen.

Case 6. Sgt. E. L. J., age 31. In February, 1919, this patient had a radical mastoid operation done on the left side, and a few weeks later this was followed by a second operation. In July, 1919, the cochlea on the same side was extirpated. This last operation was necessarily followed by complete right facial paralysis. The patient was sent to me on October 4, 1919. Electrical reactions were tested, and showed reaction of a degeneration present in the muscles of the right side of the face. On October 8, 1919, in spite of the fact that the last operation wound was not completely healed, anastomosis between the facial and hypoglossal was carried out. The operation was rather difficult. The landmarks were obscure; there was a good deal of scar tissue; and the division of the nerve into temporal and cervical divisions occurred very soon after the exit from the stylomastoid foramen so that the length of facial nerve available for union was rather short. In addition it was distinctly swollen, pinkish, and soft. At operation I was not at all satisfied with the neatness of the junction, and gave a doubtful prognosis. This gloomy view was accentuated by the fact that the wound became septic in the upper part, probably owing to secretion from the still unhealed previous wound. The patient maintained a constantly hopeful attitude and persevered with massage and galvanism for a whole year. On February 10, 1920, a note was made stating: "The face seems better although no voluntary movement is shown. It is not likely that good result will be secured in this case."

On August 23, a note was made: "There is no improvement in electrical reactions. The result in this case is almost certain to be disappointing. Recommended that he cease electrical treatment and return to work." On November 2, 1920, he rang me up to say that he had some voluntary movement, and when I saw him I was able to confirm that voluntary power was present in the zygomaticus muscle and around the mouth. Since then there has been steady although slow improvement.

Case 7. H. A. E., age 29. On February 27, 1920, this patient had a radical mastoid operation done on the right side. Facial paralysis followed immediately and was complete. Examination showed the mastoid wound incompletely healed on March 13, 1920. Electrical reactions showed no reaction to faradism. Recommended that nerve anastomosis be performed when healing of the mastoid wound was complete. On July 14, 1920, the wound had

Fig. 15. Case 7. H. A. E. February, 1921 At left face in repose; at right, in movement.

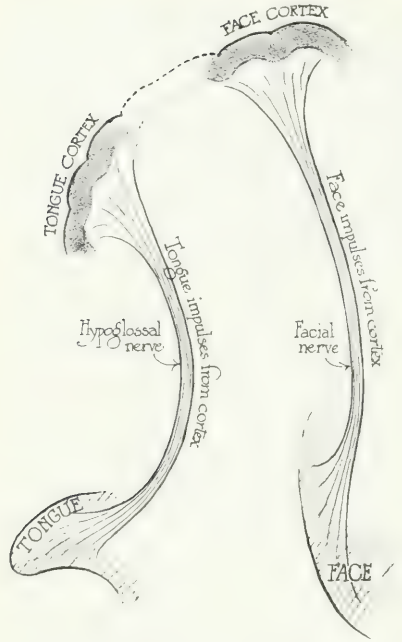


Fig. 16. Normal path of facial and lingual cortical impulses.

completely healed, and operation was done. In this case I was not satisfied with the fineness of the catgut provided and used two fine silk sutures. A stab drain was placed at the bottom of the wound to carry off excess of blood. This was removed in 24 hours. On July 19 stitches were removed and patient went to work. Massage and galvanism were begun at once and were continued for 6 months. On November 20, a note was made that there was no sign of voluntary movement but that the mouth was becoming more transverse, and the right eye was not so widely open. On December 29, 1920, voluntary power was still absent. Toward the end of January, 1921, voluntary power began to show itself in the angle of the mouth, and this has gone on steadily improving. On February 15, 1921, patient was able to whistle for the first time since his operation.

Case 8. Ex-Pte. J. H. This patient came complaining of intractable facial tic. In 1915, he was gassed and taken prisoner at the second battle of Ypres. For 3 years and 8 months he was a prisoner of war in Germany. He first noticed the facial spasm shortly after he was taken prisoner, and from that date to this it has become steadily worse. The spasm was almost continuous, it was present to some extent, he was told, even during sleep, and was a source of much embarassment to him in company, and provided an unending fund of merriment to his mates at work. He had had treatment of every possible kind, including persistent suggestion. The condition, however, continued to grow steadily worse. His own idea in coming was to have the muscles paralyzed if possible. The result of operation on the face, the probable duration of the paralysis, the loss of power in one-half of the tongue, every disadvantage that could be thought of were put before him, and he preferred to face them rather than continue a victim to the never-ending tic. Examination bore out the reasonableness of his decision, for the left side of the face was in constant movement, the left eye alternately screwed up tight and relaxed, the left angle of the mouth drawn up and indeed the whole side of the face in irregular movement. There appeared to be some weakness of the muscles combined with the spasm, for when he was asked to raise the brow, it did not rise so high on the affected as on the sound side. Again, when asked to show his teeth there was a marked difference in the two sides. The condition seemed exactly parallel to a spasmodic torticollis, a condition which like facial tic is of unknown but probably cortical origin.

Operation was performed on February 17, 1921. When patient was going under the anæsthetic, it was observed that the spasm of the muscles of the left side of the face continued until he was fairly deeply under. The facial nerve was exposed without any difficulty and it was found advisable to remove the tip of the mastoid process in order to expose the point of exit from the stylomastoid foramen. The hypoglossal nerve was then exposed, and its branches identified. It was cut far forward on the hyoglossus muscle, and turned up toward the stump of the facial. Union was made by three very small silk sutures obtained by untwisting the finest Chinese twist silk. The deep tissues were brought together with No. 1 plain catgut, and the skin sutured with horsehair. No drainage was allowed for. When seen the day after the operation he was able to express as much satisfaction with one side of his face as is normal with both sides. The relief from the constant spasm was very great. It is too early to have any idea of the ultimate results in this case, but even if paralysis should be permanent—which is not likely—and complete, the exchange from the contortions of a facial tic is a good one. In this case there was no nerve degeneration and no muscle atrophy. The operation of anastomosis was therefore comparatively easy, and done under the most favorable auspices for return of muscle function.

### Comment

A study of the literature bears out the general conclusion that return of muscle

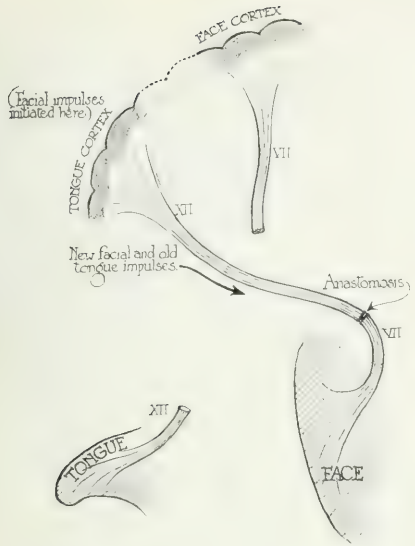


Fig. 17. Path of impulses if facial cortex ceases to function directly.

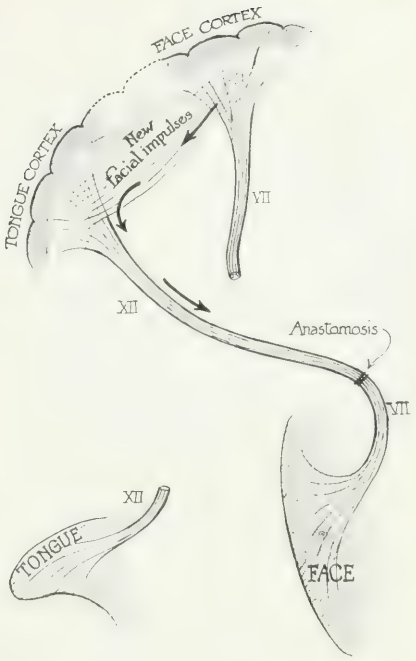


Fig. 18. Path of impulses if facial cortex functions through hypoglossal cortex.

tonus may be looked for with some degree of confidence and that a considerable amount of voluntary control of muscle movement is probable. If emotional movement of the face is desired it is usually absent. Why is this? We must bear in mind that in the cortex there are represented movements, not muscles. Probably no voluntary movement in the body is accomplished by any single muscle. For every action we have to take into account not only the "prime mover" but the antagonistic muscles which, as it were, "pay out the slack," the synergic muscles, and sometimes the muscles of fixation. The actual movement is thus a complex, not a simple phenomenon, and the cortical accompaniment is of necessity equally complex, demanding a high degree of co-ordination. The play of the facial muscles in the expression of the emotions is a very subtle complex, capable of almost indefinite combinations giving rise to infinite gradations of emotional expression. The facial cortex must likewise be capable of emitting equally numerous combinations and degrees of nerve impulse. In facial paralysis this mechanism is, to use Cushing's phrase, "sidetracked." The tongue cortex has relatively much simpler duties. Obviously the only means of re-acquiring emotional activity in the facial muscles after hypoglossal anastomosis is by educating the hypoglossal cortex to perform the complex work of the facial cortex or by connecting the facial cortex with the tongue cortex so intimately that the path for impulses from facial cortex through tongue cortex to facial muscles is as free as it was formerly when it ran directly from facial cortex to facial muscles. Either of these must be a matter of some difficulty requiring considerable time to bring to perfection. It is likely to vary in different

individuals just as the readiness with which new knowledge is acquired varies from one to another. Other things being equal, it is likely to be carried further and to be more complete the younger the age at which the change is made necessary. In all probability after middle life the formation of new paths or the acquirement of new duties by a part of the cortex is very imperfectly carried out. The facial muscles are likely to speak as it were with a lingual accent.

Bearing to some extent on this problem is the question of muscle re-education. Up to the present we have tended to regard the work of repair as practically finished when voluntary movement has been restored. Experience with cases of tendon transplantation has abundantly proved that adaptation to function in the transplanted tendons only begins when they are firmly attached to their new insertions. Even in such simple activities as are carried out with the muscles usually re-arranged, in tendon transplantation for irreparable musculospiral paralysis, the process of education takes many weeks, and the muscles which are being educated were never paralyzed at all. How much more then must we ask in the case of facial muscles which have much more complex duties to perform, which have been atrophied for a considerable time, and in the end have to receive orders from nerve cells which may be only learning their work. Education in the use of the facial muscles ought to be constant and persevering. Each patient, if intelligent enough, should have the elements of the nerve-muscle mechanism explained to him, and it should be pointed out that future improvement lies largely with himself. Apart from deliberate re-education, it is doubtful if emotional movement will ever be regained; with intelligent self-education, it is at least a possibility.

The choice of the hypoglossal rather than the accessory is in conformity with this opinion. We are accustomed to use the medium of speech in emotional expression rather than our sternomastoids and trapezii. Again, the actions of the tongue are of finer grade, and are very much more numerous than are those of the shoulders, so that nerve impulses from the cortex must be passing along the new path much more frequently in the case of faciohypoglossal than in the case of facio-accessory anastomosis. The proximity of the speech center in the cortex to the face region may also have some slight influence in the matter of developing associations between facial and lingual areas of cortex.

From the nature of the condition and from the fact that a sufficiently long period has not yet elapsed in any of the cases described, it is rather difficult to draw conclusions as to the scope of the operation and the degree of improvement to be looked for. I have, however, attempted to analyze the elements in the result, which would enable us to estimate to some extent the question of success or failure. These may be grouped according to the anatomical region: the brow, the palpebral fissure, the cheek, the mouth, and the tongue. Each of these may again be regarded from the standpoint of appearance and that of function. Thus, in regard to the brow, one may note the presence of wrinkles such that in repose the forehead looks almost normal, yet when it is intended to express astonishment by raising the brow, or by frowning to indicate displeasure, the forehead may remain impassive. Similarly in the case of the palpebral fissure, the proportions may correspond to that of the opposite side, and yet in the presence of a strong wind the affected eye may be troublesome from watering. In the case of the cheek, the appearance may be indistinguishable from that of the other side, but the food may still tend to collect between it and the gum. The mouth also gives a variable result according to whether we estimate appearance or function. The angle of the mouth may be well elevated, the oral slit exactly transverse when the face is at rest, but though the lips may be capable of performing the minor function of whistling, or even of forming the labial consonants without any trouble, the smile is apt to be one-sided. This may be an advantage in a game of poker but on most occasions it is to be counted as a drawback. On the debit side of the account must be set down the necessary interference with the functions of the tongue. In regard to the sensory function of

taste, the patient is never conscious of any difference. The motor functions of the tongue are mainly three. It is used in mastication, in swallowing, and in speech. In none of these three respects is the loss of power in one-half of the organ a very serious factor, and in all three it tends to become less noticeable as time goes on. The matter of the appearance of the tongue is of little moment; small girls alone habitually exhibit the organ.

It must be evident that the question of a successful issue to this operative procedure depends on a large number of factors most of which, variable in themselves, are variously appraised by different people. Further, the number of cases in this series is too small for us to formulate definite conclusions, but it is sufficient to warrant the opinion that facio-hypoglossal anastomosis is a measure of distinct utility, an opinion which up to the present is shared by the patients.

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# MOVABLE BODIES IN THE KNEE-JOINT[1]

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FOR many years free osteocartilaginous joint-bodies have been of great interest to surgeons, and many efforts have been made to find the true cause and manner of growth of these troublesome bodies. There may still be some doubt in the etiology, yet the clinical features are definite and the treatment is one—namely, surgical.

Hunter's *Pathology*, regarding the life history of these completely detached and freely wandering bodies, may be faulty, yet coming from the latter part of the eighteenth century it is interesting. He maintained "that blood, when effused, tended to organize and to adapt itself to the tissues in which it was effused. Hence, loose bodies in the knee were organized blood clots that became attached to the articular cartilage, assumed its character, and later, becoming detached, gave rise to movable cartilaginous bodies."

The present well accepted etiology of free joint-bodies—a piece of detached cartilage or of bone and cartilage—must be attributed to George Rainey of St. Thomas Hospital (1801-1804). He made the observation that detached loose bodies, like a cell of metastatic growth, may continue to grow in a new locality independent of its parent structure, though adhering to its character. Further studies definitely established that such free bodies are nourished by the lubricating joint fluid—the synovia; similar to the bony growth which develops in myocitis ossificans traumatica and receives its nourishment from the neighboring contiguous muscles.

While such osteocartilaginous bodies are found in all the other joints, they are more common in the larger hinge-joints, especially in the knee where they are often of traumatic origin, this joint being more subject to injury than any other joint, due perhaps to its comparatively superficial location, between the two longest bones of the body; and the fact that the knee has a double function to perform—locomotion and bearing the whole body-weight from different angles for which nature has supplied it with a very elaborate ligamentous support. These ligaments are but slightly assisted by the muscles and the bones entering into the formation of this joint.

Therefore, we may say the frequent cause of derangement of this joint, injury of the ligaments and the semilunar cartilages is due to the strenuous work it has to perform and to the peculiar motion of the joint, which is a combination of gliding and rolling (Morris).

Though this joint belongs to the ginglymus or hinge variety of diarthrosis, during extreme flexion, it has to allow a certain amount of rotation of the tibia in its long axis, and a little abduction and rotation of the leg on the thigh. According to Henderson, "the maximum of these movements occurs in the arc between an angle of flexion of about 30° and an angle of flexion of 90°. This arc may be spoken of as the arc of weakness. It is in this arc of weakness that the majority of mechanical derangements of the knee are sustained." Direct trauma especially when the knee is in flexion may result in nipping some cartilage and bone from the condylar surface of the femur. Once detached, such osteocartilaginous bodies wander about and are nourished by the joint fluid and may grow to a considerable size

A great many "joint-mice," as they are often termed, originate in the intra-articular cavity and may be a part of the semilunar fibrocartilages, which are two in number and are placed horizontally between the articular surfaces of the femur and the tibia. However, neither of them is sufficiently large to cover the whole of the tibial articular surface upon which it rests so that when, during the peculiar rolling and gliding movements of the joint, some undue pressure is brought upon the tibia it may cause the semilunar cartilage to become detached. Further, the upper and lower surfaces of both semilunar cartilages are smooth and free and each cartilage terminates in an anterior and posterior fibrous

[1] Read before The Western Surgical Association, Los Angeles, California, December [illegible], 1[illegible]

Fig. 1. Roentgenogram showing loose bodies in joint.

Fig. 2. Loose joint-bodies removed from knee of T. J. M

horn or cornu, which may be clipped off and the detached bodies may become foci of such movable bodies. Villous projections into the joint may likewise be rubbed off, float about at will and become engaged in the joint resulting in its complete "locking," accompanied by severe pain.

The synovial membrane is also of special importance in this discussion because through injury it probably becomes a frequent source of loose bodies in an otherwise healthy joint. Therefore, it will be well to recall some of its anatomical characteristics.

In the knee-joint the synovial membrane is not only the largest but the most elaborately arranged of its kind in the body—representing the fusion of three separate synovial membranes, which, in some animals, remain permanently distinct.

The portion of synovial membrane which extends from below the level of the patellar articular surface to the anterior part of the intercondyloid notch, lines the joint cavity, and forms a more or less extensive covering for the intracapsular ligaments and for the free surface of the infrapatellar pad of fat. At its femoral end it is narrow and attenuated, but at its patellar end it expands laterally to form winglike fringes or membranes, which may through disease or infection and chronic irritation hypertrophy—become pedunculated—undergo proliferation by fibrous tissue formation and be translated into calcareous formation. Through a sudden not necessarily violent movement of the joint, these osteocartilaginous fringes may be nipped off and give rise to loose joint bodies.

Even the articular surface of the synovial membrane may, through constant irritation, become papillated, causing instead of a smooth, a rough friction, a condition which will aggravate an already existing synovitis and bring about the thickening and hardening of the villi, or warty growths, which also may become liberated in the joint cavity. Such free bodies may become engaged in the articulations, also "locking" the joint. Further, during the act of "unlocking" they may be bruised and crushed. In this manner they may increase their number and keep up the vicious circle until surgical interference is sought. Thus synovitis and arthritis may be the result as well as the cause of loose bodies in the joint.

My associate, Dr. A. R. Robertson, who has been especially interested in the study of these bodies from a standpoint of pathology and etiology, made the following observation, that in a chronically inflamed joint distended with fluid, the synovial membrane is stretched, thickened, and œdematous. After a prolonged period certain areas of the thickened membrane might undergo an analogous translation into cartilage and bone. With subsidance of the fluid the membrane would be lax and flabby. In consequence the osteochondromatous areas would act as foreign bodies.

Such areas would fail to accommodate themselves to the varying movements of the joint. In time they would become pedunculated and eventually pulled away to become now a detached free body within the joint. His belief is that there is no growth after they become fully detached.

It has been stated that certain individuals suffer from a condition known as "osteochondritis dissecans," when the surface of the knee-joint is especially brittle and some insignificant trauma causes the detachment of a portion of the articular surface.

The symptoms of this affliction are usually quite typical—intermittent "locking" of the knee-joint, in the flexed position, which is accompanied by excruciating pain. During the act of "unlocking" the patient is conscious of something slipping out. The swelling in the joint that is apt to follow is due to injury to the tissues and to consequent effusion of fluid into the joint. It is quite possible, especially if the loose bodies are of considerable size and lodged in the extension of the joint upward—in the suprapatellar pouch—that they may hinder locomotion slightly as there is less likelihood of such large bodies, owing to their thickness, to glide into and become engaged in the joint. Especially is this true if the egdes of the bodies are more or less rounded and spherical in shape. Quite often the movable bodies in the knee can be easily palpated by flexing and extending the knee-joint, especially when they are located in the suprapatellar pouch.

If with the history of "locking" and with well pronounced characteristic symptoms there is to be felt dense bodies which can be moved from place to place, the diagnosis is not difficult. Often they are found and isolated by the patient. Sometimes the history of the mode of production is helpful. It is well to bear in mind that symptoms of nipping of a synovial fringe are not as pronounced and the pain is not as acute in its primary occurrence.

To make a positive diagnosis, to the clinical evidence must be added the X-ray pictures, but merely as a corroborative agent. The X-ray examination generally is a great aid in detecting any such bodies in the knee—and stereoscopic observations are especially useful in definitely locating their relative position in the joint.

A few guides to the accurate reading of such X-ray plates follow.

The picture of osteocartilaginous loose bodies is quite characteristic, as they present themselves as well defined, uniform shadows of individual structures.

Dislocated semilunar cartilage will not give any X-ray evidence, except when incrustated.

Degenerated fat pads, due to chronic disease such as tuberculosis and syphilis, may be palpated but X-ray will not reveal them.

A sesamoid bone in the internal head of the gastrocnemius in certain positions may cast a shadow which can be mistaken for a loose body.

Joint lipomata may cause "locking," may be even felt, but will not have the characteristic picture of "joint-mice."

The attending physician's first duty is to relieve pain and "locking" and establish motion. With manipulation, forced flexion, and sudden extension, the offending loose body may be dislodged. Surgery only will give lasting relief. If the presence of "joint-mice" is associated with arthritis deformans and the joint is already considerably impaired, the removal of the loose bodies will be of little benefit. It is well to bear in mind that surgery does not cure the causative lesion; therefore, similar bodies may reform.

If the treatment, as in most cases, is to be surgical, during operation the joint should be subjected to as little trauma as possible, and more than the ordinary care should be taken to guard against infection.

The method of approach in each case must be decided in accordance with the requirements in each individual and depends on the location of the joint-mice. If complete exposure of the joint is required, the longitudinal division of the patella may be imperative. But this procedure naturally entails more injury to the joint than the safer longitudinal incision of the external surface of the joint. The diagonal incision following the internal line of the joint is preferable for the removal of the internal semilunar cartilage and other free bodies within the joint.

To prevent ankylosis, mobilization of the knee should begin as early as possible.

The biology and the gross appearance of such joint-bodies is remarkably constant. In shape they are generally plano-convex or concavo-convex; the latter aspect being perfectly smooth, while the plane or concave surface is uneven, roughened, or nodulated. They may not always be found free but may be found fixed in a fossa or excavation in the articular surface of a femoral condyle—or they may be found in close relation to the crucial ligaments in the intercondylar space. On rare occasions they are pressed between the bones and lie snugly imbedded in a fossa in the articular cartilages.

It is known that denuded and injured articular surfaces of bones in time become covered over by smooth, white, hyaline articular cartilage. This is true of joint-mice as well. When carefully examined they will be found to be covered with a thick shining white layer of hyaline cartilage. Sometimes on the smaller concave side may be found a thin layer of true spongy bone, especially when the removal takes place soon after injury. Undoubtedly the appearance, shape, and biological contents of specimens depend primarily on their origin, evolution, and growth.

I wish to present briefly one case which in my experience is unique because of the size and number of bodies present and the comparative slight disability the patient suffered. Had I followed the apparent X-ray findings in this case, the joint would have been unnecessarily subjected to additional trauma by a third incision for the seventh loose body. But it proved to be the peculiar shadow of the sesamoid bone, which photographed from a certain angle gives an identical picture of "joint-mice."

T. J. M., male, age 26; truck driver. In 1912 when playing baseball he accidentally twisted his right knee. One year later he injured it again when a heavy weight fell on it.

Since the first accident he has experienced about twice a month intermittent "locking" of the knee in a flexed position at an angle of about 45°, accompanied by severe pain. With great effort the leg was straightened. Each time the patient was conscious of something slipping in the joint and then he was relieved of pain and "locking." This condition was followed by more or less swelling of the joint. There has been a constant moderate swelling since the first injury, otherwise he is in robust health and shows more than the average muscular development. He was prevented from attending to his work only twice during the history of his first trouble and then for only 2 or 3 days.

Fig. 3. Roentgenogram 1 year, 6 months after operation.

Wassermann test was negative. The other joints are in normal condition. The right knee is moderately swollen and several loose bodies can be palpated. X-ray examination revealed what appeared to be seven loose bodies in the joint, one between the articulating surfaces of the joint.

*Operation, June 9, 1919.* Removed six osteocartilaginous bodies from the right knee-joint, ranging in size from 1¼ inches in diameter to ½ inch in thickness, to the size of a small almond, one of which was attached to the joint surface by a fibrous band and located between the articulating surfaces. This one was removed through an incision about 2½ inches long following the line of the joint internally. The other five were removed by longitudinal incision external to the joint. The irregular anterior surface of the tibia indicates this area as the possible origin of these loose bodies.

*Pathological report.* The surface of specimens is of glistening whiteness, is everywhere pitted so that it presents numerous bosses. In some there is what appears to be a large depression to which a little connective tissue is attached, possibly the remains of a pedicle. Microscopic sections show a surface of dead connecting tissue beneath which this tissue shows gradual change to hyaline cartilage, the fibrocartilage, and then a beginning calcification of the interstitial hyaline substance. In places the cells undergo rearrangement into columns and true bone is formed.

He made a good recovery and has had no trouble since the operation. A recent X-ray indicates no recurrence.

# EPIDERMOID CYSTS

By HENRY H. SHERK, M.D., F.A.C.S., Pasadena, California

THE subject of this paper is not important from the standpoint of the seriousness of the condition but it is of interest because, as a pathological entity, epidermoid cysts are very seldom recognized, and, to the majority of operators, entirely unknown. A number of surgeons were recently asked as to the frequency of epidermoids in their practice. All either pleaded ignorance as to the nature of these cysts or had them confused with either true dermoids or sebaceous cysts.

Some 14 years ago the difficulty of arriving at a postoperative diagnosis of a growth, which was thought before excision to be a possible skin sarcoma, first drew the writer's attention to these cysts as differentiated from follicular, retention, or sebaceous cysts. The observation of several other cases, in the course of a few years, led him to report them to the Clinical and Pathological Society of Los Angeles, none of whose members had ever seen any of these growths.

Since then Dr. Black has been on the lookout for these cysts in the material referred to him by others for examination. Nevertheless, until the recent requirement of some of our hospitals that all tissues removed at operations must be examined by a pathologist, none had passed through his hands. But within the last year he has had 4 cases occurring in the practice of four different surgeons and during the same period the writer has operated upon 5 patients presenting this form of tumor. Evidently these cysts are of frequent occurrence but mostly unrecognized because unexamined pathologically.

The literature on epidermoids until recent years was rather scant. Garré, in 1894, comments on the rarity of anything on the subject.

The term "epidermoid cyst" has been variously used by writers to describe cysts occurring in at least three widely different localities—the pelvis, the brain, and the external surface of the body. The pelvic epidermoids of embryonic origin and those of the third ventricle (14 and 15), resulting from an inclusion of the craniopharyngeal duct, will not be considered in this paper. These latter cysts, however, are of extreme interest and importance from their relation to tumors of the hypophysis and to hyperpituitarism and hypopituitarism. Only cysts of the body surface will be discussed.

These surface cysts, as such, were first described by Garré (3) under the name of "traumatic epithelial cysts." They have been variously termed by others as atheromata, inclusion cysts, implantation cysts (Sutton), and, finally, by Franke as epidermoids. This latter name best defines their histological characteristics and is undoubtedly the most acceptable designation.

The various writers have held mainly to two opinions as to the etiology of these cysts, traumatic and congenital. There are perfectly good grounds that either theory is right in certain cases. Some are undoubtedly traumatic in origin and many others as certainly congenital.

Franke (1) was the first to discard the old doctrine of the sebaceous gland origin of atheromata. He (3) thought they were fœtal inclusion cysts.

Then Toerrok (1) further confirmed the new theory of the embryonic ensnaring of atheroma germs by a detailed histological investigation of the walls and contents of these cysts.

Unna (1) agrees with Toerrok that true atheromata are a sort of simple dermoid and are developed from embryonic aberrant germs.

Gros and Reverdin (3) were the first to suggest the traumatic mode of origin.

Bland-Sutton (11) thinks they are traumatic in origin and calls them implantation cysts.

Pels Leusden (2) believes that they have their origin in superficial tuberculous lesions; that, following suppuration, the epithelium turns inward and, creeping along the fistula, lines the whole cavity.

Csillag (12) speaks of cysts following vesicular skin diseases and in scars resulting from injuries and quotes Kaposi, Neisser, Petrinni, Crocker, Vidal, Hallapeau, Duehring, and others. Warner (8) reports a case occurring in a herpetic scar.

Blumberg (2) claims that all are cholesteatoma or pearl cysts.

Franke (1) thinks only a small part result from traumatism and that many of these are due to trauma without injury to the external surface. This latter opinion is hard to understand.

Cederbaum (4) quotes various authors as to the theories of origin and believes that only a small percentage of epidermoids are caused by traumatism.

Woerz (3) reviews 55 cases, 24 of which gave distinct history of traumatism mostly after punctured wounds, one after hammer blow, three following panaritium.

Pietzner (3) collected 73 cases, 43 having history of trauma, including dog bite, hammer blow, incised wounds, penetration with pieces of wood, punctured and contused wounds.

The theory of traumatic (3) origin is strengthened by the experimental observations of Kaufman (4), Masse (4), Ribbert (4), Manasse and Schweninger (3), that detached pieces of surface epithelium, transplanted under the skin or fascia and in tendons, proliferate and form small cysts.

Franke (2) notes the absence of ducts or external openings in epidermoids as against their being retention cysts. The presence of papillæ with the absence of sebaceous cells was noted by Toerrok (1).

A brief reference to the anatomy of the skin will aid in an understanding of the origin and the differentiation of these cysts from other cysts of the body surface.

The skin consists principally of a layer of vascular tissue, named the derma, corium, or cutis vera. External to this is a layer or covering of epithelium termed the epidermis, cuticle or scarf skin. Under the derma or true skin is the subcutaneous cellular layer containing the skin appendages, namely, hair follicles, sweat glands, and sebaceous glands.

The epidermis is an epithelial structure belonging to the class of stratified squamous epithelium, arranged in four strata, namely from within outward, rete malpighii, stratum granulosum, stratum lucidum, and stratum corneum.

The most superficial stratum of these cells, called the stratum corneum, is composed of many layers of horny epithelial scales.

It is these horny scales that, when desquamated, form the principal content of the epidermoid cyst, and the four strata of the epiderm are found in reversed position in its walls.

Only the elements of the epiderm are found in the walls and contents of these epidermoids. The dermoids, however, contain the elements of both the corium and the epidermis, as well as those of the skin appendages—hair, teeth, sweat glands, and sebaceous glands. The sebaceous cysts are follicular or retention cysts, and show the histological elements and secretion of the sebaceous glands or their ducts.

Unna (1) describes the atheromata or epidermoids clinically as "subcutaneous, indolent tumors, varying in size from that of a pea to a walnut, which distend the skin hemispherically, show no opening and contain gritty, glistening, odorless débris of horny cells, mostly occurring in the hairy scalp, often multiple, slowly growing, lasting for years, and showing periods of growth and arrest alternately." He further says: "Histologically they are defined as an epithelial collection cornified in the center and lying in the hyperderm, which is margined from the surrounding tissue by a firm or delicate connective-tissue capsule and which gradually by its pressure leads to atrophy of the adjacent tissues or their constituents."

Epidermoids (4) of traumatic origin grow more slowly and are less in size than the congenital, as embryonal cells have a greater ability to grow.

Pietzner (3) found the period of time elapsing between the causative trauma and cyst development to vary from 1 month to 24 years.

Unna (1) notes the absence of microorganisms in epidermoids and states that the typical content of the epidermoids consists of concentrically arranged horny layers,

plates of cholesterin and débris of both constituents with frequent fragments of lime and pigment.

Toerrok (1) found by osmic acid tests, the absence of sebaceous cells and, almost invariably, of fats generally.

Ether (5) will not dissolve the material contained in epidermoids.

According to Buerger (3), desquamated horny epithelial cells, granular detritus, and at times cholesterin crystals fill the interior of these cysts. He says: "In short we have the usual elements of the epiderm surrounded with connective tissue but arranged in inverse order so that the stratum corneum is innermost and furnishes the material for the cyst content."

The walls of these cysts show some or all of the elements of the epiderm, and (3) are made up from without inward first of a layer of connective tissue, then of cuboidal and polygonal epithelial cells, which become gradually flattened in the succeeding layers, until finally the innermost stratum shows only cornified epithelium.

The presence of giant cells in the cyst wall are ascribed by Stewart (7) and Cederbaum (4) to irritation by the desquamated cell content. Other writers, notably Hildebrand (7) and Williamson (7), have claimed they were due to the presence of hairs. The cells are of the foreign-body type and are only found in the granulation-tissue-like layer which lines such portion of the cyst wall as is not made up of epiderm.

Different parts of the body are given by various authors as the most common site of epidermoids.

Bland-Sutton found them most frequently on the hands and fingers and is agreed with in this by most of those who hold to the traumatic origin of these cysts.

Pietzner (3) found that 68 out of 73 occurred on the hands.

Unna thinks they are most frequent in the hairy scalp.

Dubreuith reports 13 collected cases, following various kinds of trauma including surgical operations, on parts of the body other than the hands and fingers; the forehead, tongue, buttock, penis (congenital, and following circumcision), and toes (following operation for ingrowing toe-nail).

In the author's 11 cases and the 4 observed by Black, the cysts were found in the following positions: scalp, 4; back, 2. One each on shoulder, arm, cheek, lower jaw, neck, breast, groin, buttock, finger.

In two cases there were multiple cysts, the remainder were single.

Buerger (3) found most in men; Woerz (3) reports only 7 out of 53 in women; Pietzner (3) in 73 cases, 63 male, 10 female.

In the author's 11 cases, 5 were men, 6 women; Black's 4 cases, 2 men, 2 women.

Epidermoid cysts are differentiated from sebaceous cysts by the absence of an opening and by the difference in their contents. All sebaceous cysts show an opening in the skin and, without being pricked, discharge their contents from time to time, or may have their contents expressed and their shape changed or molded by external manipulation.

The absence of all micro-organisms separates epidermoids, together with dermoids, from follicular cysts. Unna (1) lays much weight on this fact as a means of differentiation in certain large atheroma-like follicular cysts. Closed or open cysts that have contents fatty or smelling of fatty acids are never epidermoids.

The pearly luster of the contents in epidermoids is one of their most noticeable and constant characteristics. Almost as constant is their laminated and flake-like appearance.

No attempt has been made to collect or tabulate the reports of cases from the literature. Various authors in their papers have duplicated the cases and several, Bland-Sutton (10), Pilliet (9), Dubreuith (6), Little (5), Buerger (3), Warner (8), Cederbaum (4), and others have reported cases of their own, some of which were diagnosed and others mistaken for other forms of growth until excised.

I have operated upon 11 cases of epidermoid cysts. These cysts varied from ½ inch in diameter to 1¾ by 1 inch in size. All except the three of traumatic origin had existed for years, or as the patients said, "as long as they remembered."

The traumatic cysts were operated upon 1, 1½, and 14 years, respectively, after the

occurrence of the trauma. The inducing trauma were splinter driven into skin, hat-pin puncture, and blow on groin.

The cysts have always shown as nodules, more or less hemispherical, projecting from the body surface, a few unattached to but the majority firmly fixed to and a part of the skin and freely movable as to the underlying tissues. The overlying skin has, with few exceptions, been firmly attached to the cyst for a considerable portion of its external surface. They were not flattened, as are sebaceous cysts, and, unlike the latter, could not be molded or changed as to shape.

None had any external opening or duct. Nor could any of their contents be expressed. One case had a small sebaceous cyst in the overlying skin, and the odorous sebaceous material which was expressed from it led to an incorrect pre-operative diagnosis of the main cyst the contents of which proved to be entirely different.

The majority of these cysts showed enlarged and dilated capillaries in the skin overlying the summit of the nodules. One of them showed this over the whole external surface of the tumor and the overlying skin was more pigmented than the surrounding surface.

Two of the traumatic cases (splinter and hat-pin) were infected, showing inflammation and suppuration at the time of excision. The contents of none were odorous as in most sebaceous cysts.

The contents varied in the different cysts, as to consistency and color. Some were softer and some darker than others but all showed the granular, scaly, and more or less laminated horny appearance, more or less markedly pearly and glistening in spots. Some of the harder and drier contents were decidedly laminated in nature and separated into scaly flakes, occasionally quite large in size.

The cyst walls were rather thick and firm in most of the cases, the inner surfaces pearly white, and some were so typical as to contents that a macroscopic diagnosis could be made, but others were only settled with the aid of the microscope. However, the final diagnosis was made by histological examination in every case.

Giant cells were found in only two or three instances and were distinctly of the foreign body type.

A résumé of the author's cases follows.

Case 1. Miss E. B., age 20. A tumor the size of a hickory nut was present on posterior surface of left shoulder, over upper border of scapula. It had been present since early childhood. It was hard, firm, and intimately attached to skin. There were many distinctly dilated capillaries over the apex of the nodule. Pre-operative diagnosis, possible sarcoma of the skin.

Case 2. Miss M. B. Sister of Case 1. A small hemispherical nodule was present on outer posterior aspect of left arm about 2 inches above elbow. This had been present as far back as patient could remember. It was excised to see if of the same nature as cyst in Case 1 and proved to be the same.

Case 3. C. D., boy, age 14, had a small hard nodule over left side of lower jaw. It was freely movable; no history of trauma.

Case 4. L. M., man, about 40, had six cysts on back between neck and buttocks. One other had previously been excised by another operator and called sebaceous. The six cysts ranged in size from ½ to 1 inch in diameter. Two of these cysts had markedly dilated capillaries present on the surface. All six were epidermoids and it is possible the seventh one was also epidermoid in nature.

Case 5. F. K., boy, aged 12, had single cyst ½ by ¾ inch, on left cheek in parotid region, considered as a possible endothelioma before excision; no history of trauma.

Case 6. P. H. S., man, age 50, had a single cyst on scalp with thick but fragile walls. It had been present for more than six years. It was pea-sized and movable, when first noticed. It grew slowly; no history of trauma.

Case 7. J. F. H., man, age 62, had single cyst near nipple of left breast, at site of splinter penetration two years previously. One year later a lump appeared. He was operated upon 2 weeks after extrusion of piece of splinter associated with suppuration. The cyst was about ¾ inch in diameter, apparently in the skin, quite close to the nippel, but could not be definitely connected with the mammary gland. The whole breast was excised for fear of possible malignancy.

Case 8. E. D., woman, age 60, had a single cystic mass involving the skin of the left groin well up toward the anterior superior spine of ilium. It was the size of a small hen's egg, slightly irregular in shape, had many enlarged capillaries on its surface, and was somewhat pigmented. Contents were distinctly yellowish in spots from cholesterin crystals. It had been present for over 10 years, appearing soon after accidental trauma, was opened and swabbed out some years after first appearance. It grew slowly and finally became sensitive to pressure of corset.

Case 9. N. H., woman, age 22, had single cyst on back to left of mid-line, in lower dorsal region. It had been present for years. There were no enlarged capillaries on surface. It was supposed to be sebaceous cyst, but proved to be epidermoid on excision.

Case 10. G. H., woman, age 42, had single cyst of scalp ¾ inch in diameter. Noticed 7 months prior to operation, following trauma by hat-pin, which had occurred 3 or 4 months before appearance of tumor. It was inflamed and suppurating at time of operation and the cyst wall was firmly adherent to surrounding tissue and came out piecemeal. Contents were laminated and horny. It was macroscopically an epidermoid.

Case 11. J. R., woman, age 57, had three cysts on scalp, ½ to ¾ inch in diameter. She had had three others, one of which suppurated and discharged; the other two were removed by another operator and called sebaceous cysts. Of the three remaining cysts, two had been inflamed previously and were very adherent, the third shelled out easily. All three were epidermoids and it is most probable that the other three were of the same nature.

The four cases observed by Dr. Black were as follows:

Case 1. Case of Dr. C. G. Toland. Woman, age 50, suffered crushing trauma of finger, 1 year previous to operation. There was no bleeding at time of injury, but intermittent swelling, with recent appearance of white spot, associated with pain. The cyst was removed and showed characteristics of epidermoid.

Case 2. Case of Dr. L. B. Morton. Male, age 30, had cyst of gluteal region, size of small orange. There was no history of trauma. A cyst was present 9 years. It was excised after 2 years but reappeared. A second excision was done by Dr. Morton and the cyst did not recur.

Case 3. Case of Dr. J. H. Forbes. Woman, age 58, had cyst 1½ inches in diameter on scalp to side of occiput, above neck. There was no history of trauma.

Case 4. Case of Dr. Paul Ferrier. Male, age 50, had cyst on back of neck, to left of spine, the size of a lemon. It was not supposed to be traumatic. It had existed over 2 years, was inflamed, and had been lanced once. Contents were of foul odor, laminated, and pearly.

SUMMARY

Epidermoids are evidently of fairly frequent occurrence, but almost invariably unrecognized.

They are almost always mistaken for sebaceous cysts.

They may be either traumatic or embryonic in origin.

The pearly, horny, and laminated contents make their recognition easy.

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# INTUSSUSCEPTION OF THE ILEUM IN ADULTS, DUE TO BENIGN TUMORS[1]

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MOST authorities are agreed that intussusception is the cause of more than one-third of all cases of intestinal obstruction, and that the majority of the cases occurs in childhood. The incidence of intussusception decreases as age increases, and cases occurring after middle life are apt to find their way into the literature.

Eliot and Corscaden (1) in a review of the subject of intussusception make the statement that while this condition in infants and children is carefully and exhaustively described in textbooks and in the literature, the consideration of the same lesion in adults is almost universally neglected.

The case here reported occurred in a man 49 years old. The intussusception was situated in the ileum and was caused by a myxoma, which is one of the rarest of benign growths found in the intestine.

There are many causes of intussusception and cases are reported in the literature as being due to diarrhœa and ulcerative conditions of the intestine, benign and malignant growths, Meckel's diverticulum, intestinal parasites, heavy lifting, trauma, and the use of purgatives.

In 1884, Treves (5), in a classic prize monograph, reviewed the subject of intussusception from every angle and stated that polypi of the intestine were present in 5 per cent of the cases, and called attention to the fact that the tumor is usually attached to the apex of the intussusceptum. Following this publication of Treves' monograph, several authors reported cases of intussusception of the small intestine due to tumors.

Histologically polypus, lipoma, myoadenoma, fibroma, myxofibroma, myofibroma, myxoma, cyst of the ileocæcal valve, and papilloma, are all mentioned among the benign tumors causing intussusception; and of the malignant tumors reported there are different varieties of carcinoma, sarcoma, myxosarcoma, melanotic sarcoma, and epithelioma. Considering the intestine as a whole, one-seventh of the cases of intussusception are due to malignant growths, while one-fifth are due to benign tumors. Of tumors of the large bowel causing this lesion the proportion between benign and malignant is about equal, while in the small intestine benign and malignant bear the relation of two to one.

## CASE REPORT

Eight years ago, the patient, a male aged 49, had a severe attack of what was considered dysentery, when he passed a considerable quantity of blood and mucus. There was a period of 5 years of complete health when he began to have indigestion. This has persisted and has been accompanied by colic-like pain from 1 to 2 hours after taking food. This pain has increased markedly in frequency and severity and with it there has been passing nausea. Three days before operation there began severe general abdominal pain with nausea. The next day he began vomiting. The bowels did not move in spite of heavy administration of purgatives. Blood was not vomited nor defæcated at any time except during the supposed attack of dysentery.

When I first saw him the abdomen was much distended, he was becoming toxic and there was evident complete intestinal obstruction, and immediate operation was advised. At operation, through a right rectus incision the ileum was found intussuscepted for a distance of 4 inches. The gut was angry looking and at the apex of the intussusception could be palpated a small mass. Reduction without traction was accomplished and the mass was determined to be a rounded tumor arising from the inner wall of the intestine and filling its lumen. The basilar attachment was too broad to admit of excision of the tumor alone, and enterectomy and vertical anastomosis were done. The patient made a smooth recovery and has reported himself several times as in complete health. The tumor and a portion of the the excised gut were sent to the surgical laboratory of Dr. Charles H. Frazier for examination.

*Pathological report.* Specimen consists of a portion of intestine measuring 7 centimeters in length. One margin is free, the opposite one is slightly infolded and the lumen is obstructed by a solid mass. On opening the bowel the growth is seen to be attached to one margin. The tumor measures 3.5 centimeters in length by 3 centimeters in width. It is covered by mucous membrane which is intact throughout. The tumor has caused almost complete obliteration of the intestinal lumen. On cross sec-

[1]Read before the North Carolina State Section, Clinical Congress of American College of Surgeons, Charlotte North Carolina, January 23, 1921

tion the mass is solid, homogeneous, and white in color.

*Microscopic examination.* Cross section through the tumor shows a mucous lining which is preserved in part, in many areas the glands have undergone destructive changes. In these situations there is much inflammatory reaction and the mucosa as well as the tissue beneath are infiltrated with leucocytes. There is a narrow band of tissue separating the mucosa from the underlying parts. The tissue here is composed of cells, spindle in shape, the nucleus taking a deep stain, the protoplasm drawn out forming interlacing fibrils, between which is a homogeneous material taking a faint blue stain. This tissue extends into the muscular coats separating and destroying the fibers, the individual fibers are seen traversing the myxomatous areas. Diagnosis: myxoma.

Practically no part of the intestinal tract is immune to intussusception due to or, at least, associated with tumor. Thompson (7) reports a case due to polypus of the pylorus, and Lane (8) one in which a benign tumor of the large intestine protruded from the anus.

It seems obvious that a larger proportion of benign than of malignant tumors produce intussusception in the small intestine. This is due to the fact that benign varieties are more prevalent in this location and also because they produce less alteration in the structure of the bowel; even when recurrently invaginated it is still comparatively soft and pliable. Malignancy, on the other hand, renders the bowel thicker, firmer, and more difficult to infold.

An epoch-making monograph on the subject of intussusception was published in 1898 by D'Arcy Power (2). This authority states that intussusception in children is nearly always spontaneous, and postmortem examination does not often reveal any definite cause for its occurrence, but that when it appears in an adult a determining cause can nearly always be found. In the adult it may be physiological, for the invagination may follow upon a direct injury to the abdomen, and in some cases it is as truly spontaneous as it is in children, but far more frequently the cause is some form of new-growth.

The most noteworthy contribution to this subject since Power's monograph is the splendid collective review of Eliot and Corscaden which I have taken the liberty to quote. They based their work entirely on the lesion in adults, and analyzed three hundred cases taken from the literature. In this series there were sixty instances of benign tumor, and forty instances of the malignant type associated with obstruction. Of the benign class the majority had their origin in the inner layers of the intestinal wall, usually by a constricted or pedunculated base, and projected into the lumen, thus forming a more natural nidus for irritation than the less frequent subserous growths that project into the peritoneal cavity. Illustrating the latter type Willard (3) has reported a very interesting case caused by a subperitoneal lipoma. Officer (4) has reported a case in which there were forty-one polypi of the intestinal tract which caused repeated intussusceptions.

This recurrence of intussusception is a phase of the subject that to me seems important. From a perusal of the literature of the cases operated upon I would say that many of the patients have been subjects of repeated invaginations in some degree. This seems borne out by the history over rather a prolonged period, and at times by the condition of the intestine when exposed. One can easily imagine tumors, such as the one present in my case, which fitted the bowel closely, becoming inflamed and engorged and in themselves totally obstructing the bowel, but one would not expect the short period of symptoms with sudden relief that these patients experienced.

Concerning the course and symptoms of these benign tumors of the small bowel, the first manifestation will probably be slight obturation, followed later by chronic stenosis and perhaps recurring intussusception, with the final development of complete obstruction. Early symptoms may be absent or slight and the patient may be suddenly stricken. More often the symptoms are progressive and vary with the location of the growth. The higher the situation of the tumor in the bowel, the later will be the development of symptoms, because of the fluid state of the intestinal content. Recurrent invagination is accompanied by colic-like pain, passing nausea, and sudden relief, and may be present at decreasing intervals for a prolonged period before obstruction results.

As to frequency, if we go to the autopsy table for information we find benign tumors of the small intestine much more common than the general literature would indicate. Willis (6) in a recent paper estimates it as nearly one in every four hundred autopsies.

Not every benign tumor causes intussusception, but it always has potential possibilities. Some cases will be free from symptoms until obstruction occurs, but if we bear in mind the possibility of the existence of tumor when dealing with obscure abdominal conditions it would seem that, in a certain number of cases, we should be able to make a diagnosis before total obstruction results. Certainly when operating for intussusception in an adult, if reduction is accomplished, we have not done a complete operation unless we search carefully for a co-existing tumor and remove it if present. If we fail to do this a recurrence of the intussusception is to be expected.

## CONCLUSIONS

1 While intussusception is essentially a disease of childhood, it is found in adults with sufficient frequency to make it of surgical importance.

2. Intussusception in childhood is usually spontaneous. In intussusception in adults a demonstrable lesion can ordinarily be found.

3. The most common cause for intussusception in the small intestine in adults is a benign tumor.

4. Benign tumor of the intestine can often be diagnosed before obstruction occurs.

5. Recurrent invagination is often present previous to obstruction.

6. After surgical reduction of intussusception, tumor must be sought for and if one is present it must be removed in order to prevent recurrence.

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# SUBDIAPHRAGMATIC ABSCESS

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SUBDIAPHRAGMATIC or subphrenic abscess may be defined as a collection of pus beneath the diaphragm, but in direct contact with it.

Barlow, in 1845, described the condition, Hilton Fagge, in 1873, and 1874, published some interesting observations on it, but it was not until 1879 that the first operation was recorded by von Volkmann.

It is necessary to have a clear mental picture of the anatomical boundaries of the subphrenic space in order to appreciate the possible etiological factors and the sequelæ of an abscess located in this region. An exact knowledge of the anatomy of the space is also important in determining the nature of the operation necessary to insure the easiest access to the abscess and its complete drainage. The textbook descriptions of the anatomical boundaries and of the extent and route of extension of subphrenic abscesses are vague and indefinite. Barnard's detailed description of the space is probably the most complete for practical purposes; however, it is somewhat illogical and not altogether anatomically correct. He describes six areas on the under surface of the diaphragm; four intraperitoneal and two extraperitoneal. The four intraperitoneal spaces are separated and defined by the cruciform arrangement of the peritoneal folds or ligaments of the liver, namely: the falciform, the coronary, and the right and left lateral ligaments. The right extraperitoneal subphrenic space occupies the uncovered area between the layers of the coronary ligament as they are reflected onto the diaphragm, while the left extraperitoneal space is described as the area above the pole of the left kidney where the peritoneum reflects on to the diaphragm.

The peritoneal cavity may be divided into supracolic and infracolic portions, the former being the portion above the transverse colon and the latter the portion below. The supracolic area is divided by the falciform ligament into a right and left portion, and these are again divided transversely by the coronary ligament and the right and left lateral ligaments to form four areas: (1) the right anterior intraperitoneal, (2) the right posterior intraperitoneal, (3) the left anterior intraperitoneal, and (4) the left posterior intraperitoneal (Fig. 1).

In the right anterior intraperitoneal space, described by Barnard, the convexity of the liver is below and the corresponding concavity of the diaphragm is above. The falciform ligament forms its medial boundary and behind passes to the right lateral ligament of the liver. If an abscess forms in this space, it is shut off from the peritoneal cavity in front by a variable line of adhesions, usually of the transverse colon and omentum if the etiology is perforating gastric ulcer or duodenal ulcer, but if the etiology is an inflammatory extension from behind or from within the liver, the anterior border of the liver becomes adherent to the diaphragm and itself forms the lower boundary. The right anterior intraperitoneal cavity has important connections. At its posterior and outer part it communicates around the margin of the liver and around the extremity of the right lateral ligament with the right posterior intraperitoneal cavity, or the subhepatic pouch (Morison). At the same point it is directly continuous with the right lumbar fossa or right paracolic groove which lies between the ascending colon and loin, and extends down to the cæcum and thence into the pelvis. Because of its location and free connection with adjacent fossæ, an abscess develops more frequently in this space than in any of the other subphrenic areas. This space is in reality the only true subphrenic space on the right side, and it is questionable if it should not be classified as the right subphrenic space.

The right posterior intraperitoneal space is an irregular pyramid-shaped area extending transversely beneath the overhanging margin of the liver. It is bounded laterally by the wall of the abdomen, anteriorly by the liver and gall-bladder, and posteriorly by the upper

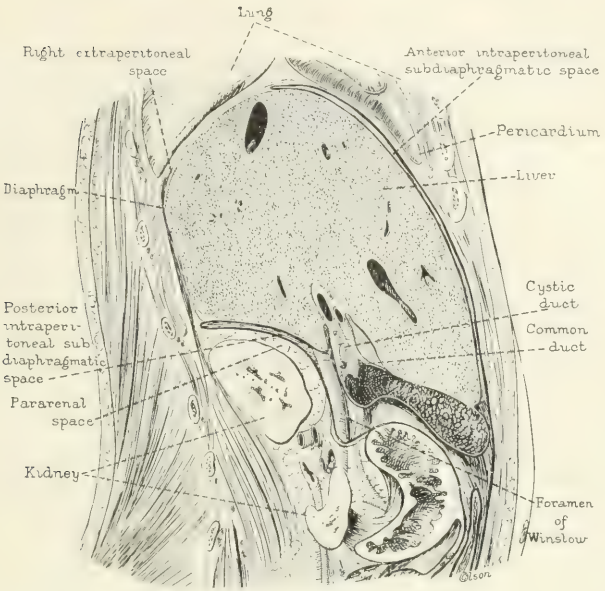


Fig. 1. Diagrammatic longitudinal section showing the relations about the diaphragm on the right.

pole of the kidney and crus of the diaphragm; medially the apex is formed by the sloping margin of the left lobe of the liver and by the common bile duct and duodenum. Here it connects through the foramen of Winslow with the left posterior intraperitoneal space (the lesser peritoneal cavity). Above, to the right, is the right lateral ligament and the liver, and medially (left) the transverse fissure.

If an abscess forms in this area it is walled off below by adhesions between the margin of the liver and the surface of the stomach medially, and below and laterally by adhesions of the great omentum and transverse colon to the margin of the liver and the anterior and lateral abdominal wall. This space is continuous laterally with the right lumbar pouch or paracolic groove and with the right anterior subphrenic space. It connects through the foramen of Winslow with the left posterior intraperitoneal space, but usually this opening seals off early in the presence of inflammation. The area is but feebly shut off from the left anterior subphrenic space. This space lies at a lower level and is not strictly posterior to the right anterior intraperitoneal space. It is certainly more descriptive to speak of it as the right kidney pouch (Morison) or the subhepatic fossa (Cantlie).

The left anterior intraperitoneal space occupies the so-called dome of the stomach's chamber, and an abscess in this area is often spoken of as perigastric or perisplenic. It is bounded above by the diaphragm; medially (right), by the left lobe of the liver, the falciform ligament and the reflection of peritoneum forming the gastrohepatic ligament; laterally (left), by the spleen, the gastrosplenic ligament, and the abdominal wall, and extends as far back as the left lateral ligament of the liver. Adhesions of the anterior surface of

TABLE I.—PRIMARY LESIONS

| | Cases | Stomach | Duodenum | Liver and Gall-Bladder | Thorax | Appendix | Local |
|---|---|---|---|---|---|---|---|
| Barnard's | 76 | 21 | 5 | 15 | 9 | 12 | |
| Mayo Clinic | 100 | 12 | 10 | 33 | | 22 | 16 |
| Finkelstein | 252 | 67 (26.6 per cent) | | | | | |
| Lance | 943 | | | | | 222 | |
| Piquand | 890 | | | | | 191 | |
| Mayall | 179 | 20 per cent | | | | 50 (28.5 per cent) | |
| Perutz | 214 | 70 (32.7 per cent) | | | | | |
| Cases collected by Archibald | 448 | | | | 18 | | |

TABLE II.—SUBPHRENIC ABSCESS OF APPENDICEAL ORIGIN

| | Cases |
|---|---|
| Collected | 20 primary or pre-operative<br>17 early postoperative<br>3 late postoperative |
| Sonnenberg's Clinic | 9 (of 600 cases of appendicitis) |
| Ross | 30 (0.8 per cent of 3391 cases of appendicitis) |
| Treves | 6 (of 1000 cases of appendicitis) |
| Kelly and Hurdon | 7 (in 410 consecutive necropsies) |

Subphrenic abscess develops in 0.6 to 1 per cent of all cases of appendicitis.

the stomach and great omentum to the abdominal wall limit it below if an abscess forms. The floor of the space is formed by the anterior surface of the cardiac end of the stomach, the spleen, the left kidney, the adrenal, and the tail of the pancreas. The boundaries of this space are extremely variable. It is but lightly shut off medially from the right posterior intraperitoneal space and laterally is continuous with the left lumbar fossa or paracolic groove. It is the true subphrenic space on the left.

The left posterior intraperitoneal space is merely that contained in the lesser sac of peritoneum. The liver, lesser omentum, and posterior wall of the stomach bound it anteriorly; the left crus of the diaphragm, the pancreas, and the upper part of the left kidney and suprarenal bound it posteriorly. Laterally there is one surface of the spleen, below is the transverse colon, and medially or to the right is the duodenum and the hepatic artery, portal vein, and bile ducts with the posterior surface of a gastrohepatic fold of peritoneum, forming the anterior wall of the foramen of Winslow, through which the space connects with the right posterior intraperitoneal space. This cavity is not directly posterior to the left anterior intraperitoneal space, and it is more descriptive to speak of it as an abscess in the lesser sac.

### ETIOLOGY

Subphrenic abscesses are due to many causes, and the location of the abscess or abscesses depends usually on the primary etiological factor. The abscess may result from direct infection or soiling, or from a pyogenic infection borne to the area from a focus elsewhere. Approximately two-thirds are the result of soiling from a viscus within the abdomen, either before or following operation; one-sixth are the result of extension from an adjacent abscess (such as a perinephritic abscess); and one-sixth are the result of distant foci of infection. A high percentage of these abscesses follow an abdominal operation. Undoubtedly gravity plays an important part in the selection of one of the subphrenic spaces for the development of an abscess, particularly postoperatively. In an examination of the abdomen, the posterior abdominal wall is seen to be divided by the vertebræ into two deep gutters. These

are divided transversely into the subphrenic pouches above, and are separated by the muscles of the loin, the kidney, and the pararenal fat, from the pelvic cavity below. If a patient is confined to bed by any condition which produces fluid within the peritoneal cavity, and is not in the partial sitting posture, fluid tends to accumulate in the subphrenic areas instead of flowing down over the lumbar elevations into the pelvis where absorption is not so rapid, where abscesses are not so prone to develop and where if they do develop, they can be more easily dealt with, at least in the female. Undoubtedly, subphrenic abscesses are more common in males than in females, possibly because the anatomical variations between the pelvis of the male and female allows the paracolic grooves to drain more readily into the pelvis of the female than the male. In 113 patients observed in the Clinic, 84 were males and 29 were females.

Subphrenic abscesses are due to the perforation of a hollow viscus within the abdomen, such as perforating gastric ulcer or duodenal ulcer, appendicitis, infected gallbladder, abscess of the liver, kidney, spleen, or pancreas, traumatism, peri-œsophageal suppuration, degenerating carcinoma, infected spinal abscess, affections of the ribs, pyæmia, pneumonia, empyema, lung abscess and distant foci of infection, such as carbuncles, cellulitis, and so forth.

With the suspensory ligament as the dividing line, abscesses of hepatic, appendiceal, or duodenal origin usually form to the right; those from perforation of the stomach, or infections of the spleen and pancreas, are to be found to the left. It is surprising, however, that so many left-sided abscesses are of appendiceal origin.

Perforating ulcers of the anterior wall and greater curvature of the stomach are more likely to cause localized or general peritonitis than those of the lesser curvature and posterior surface, which tend to the formation of subphrenic abscess. In 76 cases reported by Barnard, 21 were due to gastric ulcer and 5 to duodenal ulcer. Among 252 cases reported by Finkelstein, 67 (2.6 per cent) were due to lesions of the stomach. Of 100 cases in the Clinic, in which the etiology was fairly definite,

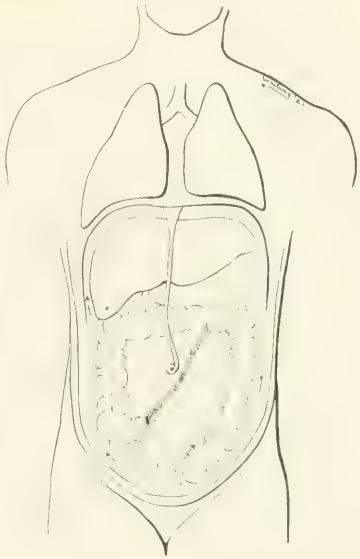

Fig. 2. Diagrammatic illustration of lymph channels.

there were 3 due to carcinoma of the stomach, 9 to gastric ulcer, and 10 to duodenal ulcer (Table I).

Subphrenic abscess is too commonly of appendiceal origin. It occurs usually in a gangrenous, retrocæcal, or highly placed appendix. Undoubtedly, it was a more common sequela of acute appendicitis when patients did not come to operation as early as they do now and when drainage was more generally practiced, and especially in patients in whom drainage merely was instituted, and the appendix left to be removed later (Table II). The mode of the spread of infection to subphrenic areas is by—

1. Direct extension by gravitation from a general or adjacent localized peritonitis.
2. Direct extension from the lower peritoneal fossa (pelvic cavity).
3. The portal vein.
4. Lymphatics.
   a. From the right retroperitoneal cellular tissue.

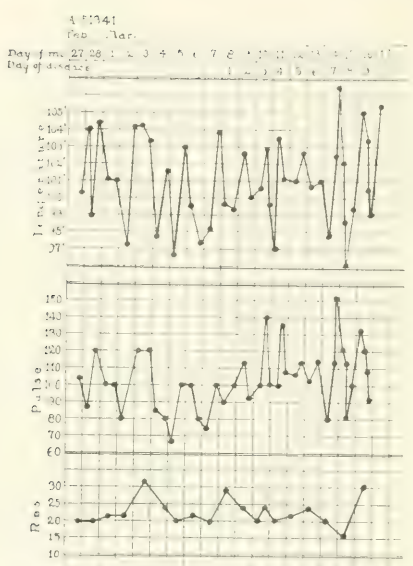

Fig. 3 (51341). Subphrenic abscess following cholecystostomy. Acute course in a very acute exacerbation and death. Note the very high temperature with accompanying pulse.

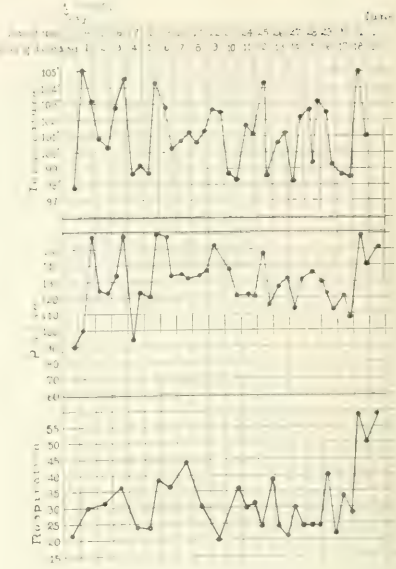

Fig. 4 (315851). Subphrenic abscess following empyema. Note the marked variation in temperature, pulse and respiration with infection localized to diaphragm in this case, above and below.

b. From around the deep epigastric artery to the falciform ligament (Barnard). The lymphatics of the appendix, those of the ileocolic juncture, and those of the ascending colon are closely associated.

c. From the subphrenic lymph plexus which communicates through the lymph vessels which pierce the diaphragm, with the subpleural plexus on its superior surface; thereby with pus under tension infection may spread in either way (Fig. 2).

5. General infection through the blood stream.

The organisms usually found in subphrenic abscesses are *bacillus coli* associated frequently with streptococci or various types of anaerobes.

The content of a subphrenic abscess varies with the etiology and may consist of caseous débris, bile, liver cells, ecchinococcus cysts, carious bone, and occasionally of gastric or duodenal contents.

The pathological process is infection, liquefaction, necrosis and pus, the reaction forming a granulating protective tissue barrier. It requires apparently about 2 weeks for the abscess to wall off; therefore, earlier transpleural drainage should not be considered. Usually the perforation in the wall of the stomach or duodenum closes spontaneously with the development of the abscess, and a permanent fistula is rare. Gas, which is present in approximately one-third of all cases, is due either to an anaerobic infection, or, more rarely, to direct connection from intestine or stomach. The abscess may be unilocular or multilocular.

### SYMPTOMS

The symptoms of subphrenic abscess vary with the etiology, with the location of the abscess, and with the general resistance of the

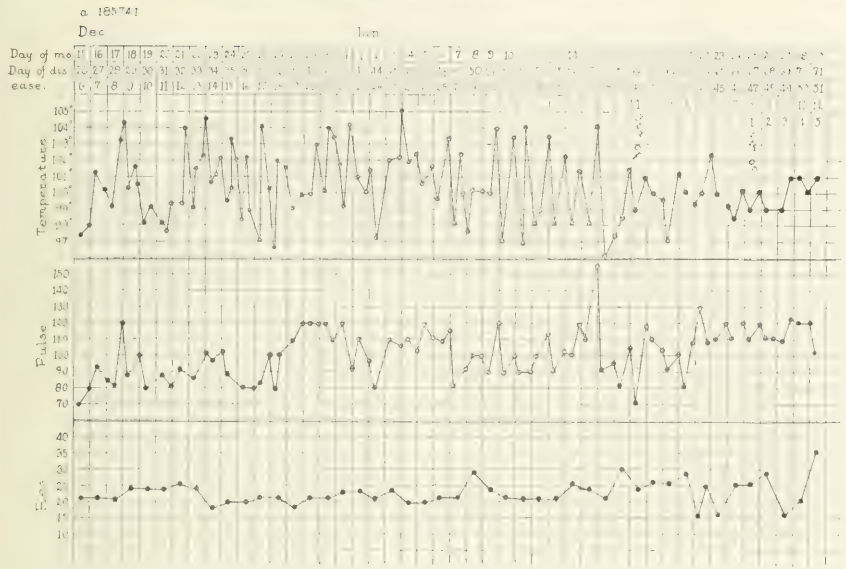


Fig. 5 (185741). Subphrenic abscess following drainage of appendiceal abscess. Note the very long course of disease, 71 days, with high temperature but little respiratory change; eventual recovery.

patient. They also vary with the onset of the disease, whether it is acute, insidious, or insidious with an acute exacerbation.

As the condition, in more than two-thirds of the cases, follows an abdominal operation, it should be suspected at once in a patient who maintains, for no obvious reason, an elevation of temperature and pulse after such an operation.

A long history of duodenal ulcer or gastric ulcer, or repeated attacks of cholecystitis or of appendicitis should lead to the suspicion of abscess in patients not operated on. The most constant symptoms are:

Varying degrees of temperature, usually showing a marked variation (the church steeple type), with a corresponding increase in the pulse rate. The respiratory rate rarely follows the temperature pulse curve. The temperature and pulse curves, especially if associated with a chill, are practically always diagnostic of inflammation around the diaphragmatic level (Figs. 3, 4, and 5).

Pain at the costal margin referred also to the back and frequently to the shoulder area. Deep pain can usually be elicited by pressure over the costal margin from the front to the back or from side to side.

The leucocyte count varies; it is usually high in acute cases. Occasionally a leucopænia is found, and in such cases the abscesses are of the insidious type, and had formed some time before the patients came under observation, or in a small percentage of cases, when the patients were in an advanced state of emaciation and generally lowered resistance. Sweating occurs. Rigors are common at some stages. A short catchy diaphragmatic cough is often present. Dyspnœa is observed occasionally. Vomiting and hiccough occur at some stage in about 50 per cent of the cases. Emaciation and weight loss is progressive in practically all cases. Inspection in approximately 60 per cent of the cases reveals a mass or bulging either in front, laterally, or posteriorly at the transcostal

TABLE III.—FACTORS DIFFERENTIATING SUBPHRENIC ABSCESS, PLEURISY WITH EFFUSION, AND ABSCESS OF THE LIVER

| Subphrenic Abscess | Pleurisy with Effusion | Abscess of the Liver |
|---|---|---|
| Postoperative abdominal sequelæ, or prolonged intra-abdominal or inflammatory focus elsewhere | More common following influenza, pneumonia, and exposure to colds, and so forth | A history of dysentery (amœbic). Usually blood infection |
| Temperature of church steeple type, associated with rigors and sweating | Temperature may be high at first, also with rigors, but not so often of the church steeple type and the respirations are usually rapid | Temperature and pulse curve much the same during the suppuration stage, but not early in the disease. Respiration not often increased |
| Breath sounds well into the dull or tympanitic area of the abscess | Breath sounds cease abruptly | Less marked extension of dullness upward |
| Little variation in the fluid level, unless gas is present; then usually succussion splash | Level varies with the position of the patient | |
| Heart rarely displaced. Dyspnœa and cyanosis rare | Heart frequently displaced. Dyspnœa and cyanosis common | |
| Liver usually pushed down without being enlarged | Occasionally rotated downward and outward | Liver enlarged and tender |
| Icterus occasionally when the abscess has ruptured through the liver capsule and into the bile canaliculi | None | Icterus not common, but a peculiar greenish yellow tint to the skin |
| Diaphragm high | Diaphragm low | Diaphragm may be high, but irregular |

plane. The abdominal thoracic movement is usually limited on the affected side, and, particularly in the early cases, the interspaces directly over the abscess are frequently retracted. The latter sign is valuable in the early questionable cases. Further physical examination reveals a limitation of the diaphragmatic excursion, and some elevation on the affected side. The liver may be pushed down, and the stomach may be displaced downward or forward. Very often there are signs suggestive of a basal intrathoracic involvement, such as dullness on percussion, and diminished breath sound and fremitus. Occasionally pleural friction sounds are heard; they are probably present in all cases at some time during the development of the abscess, but are not always recognized, since the pleuritis or perihepatitis resolves speedily. Careful physical examination reveals a different picture as the abscess develops. The friction rub may persist or disappear. As the abscess extends there is an increasing area of dullness, and in percussing down the back normal resonance is usually elicited, then increasing dullness due to compression of the lung only; then dullness due to a collection of pus, or, if there is gas in the abscess, a variable area of hyporesonance, and then absolute dullness that may or may not merge into the liver dullness. At times there is a coin sound over the stomach that is transmitted through the abscess to the dull area. The succussion splash, or *bruit d'airian*, may be heard over the area of hyporesonance, if the patient is rolled from side to side.

Although the presence of gas in subphrenic abscesses was recognized by Barlow and although Fagge had described it, it was not until von Leyden published his classical paper on "Subphrenic Pyopneumothorax Abscess" in 1880 that it was generally recognized.

### ROENTGEN-RAY FINDINGS

Probably the most valuable aid in the diagnosis of subphrenic abscess is the roentgen ray. In early cases, or in extraperitoneal abscess, or in the right posterior intraperitoneal abscess, the diaphragm may be only slightly elevated, but may show a fairly characteristic irregularity. On the other hand, the diaphragm may be as high as the third or fourth space and absolutely regular in outline. In the usual picture the diaphragm is raised to the

TABLE IV.—MORTALITY IN GROUPS OF CASES OF SUBPHRENIC ABSCESS

| | Patients with subphrenic abscess | Patients operated on | Deaths | Patients not operated on | Deaths |
|---|---|---|---|---|---|
| Barnard | 76 | 64 (73 operations) | 24 (37.5 per cent) | 12 | 12 |
| Michel and Gross | 44 | 19 | 9 (47.3 per cent) | 25 | 25 |
| Eisendrath | 106 | 84 | 23 (27.3 per cent) | 22 | 18 (82.0 per cent) |
| Sachs | 15.3 per cent<br>50 per cent | during first three weeks after first three weeks | 37.5 per cent | | |
| Lang | 176 | 52.1 per cent | | 87.7 per cent | |
| Maydl | | 35.7 per cent | 56 per cent | | |
| Elsberg | | 22 per cent | 40 per cent | | |
| Sonnenberg | | | 42 per cent | | |
| Mayo Clinic | 113 | 81 | 27 (33.3 per cent) | 32 | 31 (96.8 per cent) |

fourth space, and shows some cupping. The lung is not collapsed, but is merely pushed up. The outline of the diaphragm is more uniform than in cases in which the diaphragm is elevated by an abscess of the liver. The line of the diaphragm is more irregular when it has been caught up by an old pleuritis or by a partial collapse of the lung. Gas can usually be discovered by the roentgenogram, and gas and fluid by the fluoroscope. With fluid in the pleural cavity the diaphragm is usually low; it is irregularly high from an early pleuritis, and the fluid is a later development. In such cases, however, the costophrenic angle is generally blotted out, whereas in subphrenic abscess one or both angles are often clear. The degree of movement of the diaphragm can be accurately determined only by the fluoroscope. Full sized stereoscopic plates and thorough fluoroscopic examination are essential in the diagnosis of these cases (Figs. 6 and 7).

The differential diagnosis of subphrenic abscess usually lies between pleurisy with effusion and abscess of the liver, but perinephritic abscess, hypernephroma, cysts, and aneurism of the lower thorax or upper abdominal aorta, must also be considered. The clinical history of the condition is the most valuable feature in the differential diagnosis, and if carefully obtained, associated with the X-ray findings, and exploration with the needle, should clearly determine the site of the abscess. However, certain factors help to differentiate subphrenic abscess, pleurisy with effusion, and abscess of the liver (Table III).

It is not an easy matter, before operation, to determine the exact site of the abscess. Certain of the symptoms are common to all subphrenic abscesses; but others should clearly suggest the localization of the infection. Pain varies with the position of the abscess. Epigastric pain with bulging or a palpable mass in the epigastrium points to a left anterior or posterior subphrenic abscess, and an easily palpable mass in the epigastrium associated with pain is more commonly due to a left anterior intraperitoneal abscess than to a left posterior intraperitoneal abscess. Bulging from the middle axillary plane forward along the subcostal plane is more common with a right anterior intraperitoneal abscess than with a right posterior intraperitoneal, or a right extraperitoneal abscess. The pain accompanying the right posterior intraperitoneal abscess is deep, and more of an ache, and the pain with a right or left extraperitoneal abscess is usually more acute and the area over it is more tender than with intraperitoneal abscess. The febrile reaction is usually not so acute in the extraperitoneal types as in the intraperitoneal, also, the leucocytosis is not so high. Focal infections and lesions of the kidney more often produce extraperitoneal than intraperitoneal abscesses, whereas intraperitoneal abscesses usually come from an intra-abdominal cause.

The position of the liver is not altered by a left extraperitoneal abscess and often not greatly altered by a right extraperitoneal abscess. The right anterior intraperitoneal abscess usually pushes the liver down, whereas

TABLE V.—EIGHTY-TWO CASES DIAGNOSED SUBPHRENIC ABSCESS

| | |
|---|---|
| Males 66, females 16 | 82 |
| Males died | 23 |
| Females died | 4 |
| Longest time after operation 20 months | |
| Shortest time after operation 1 day | |
| Average time after operation 84 days | |
| Age less than 11 | 0 |
| Age from 11 to 20 | 2 |
| Age from 21 to 30 | 17 |
| Age from 31 to 40 | 23 |
| Age from 41 to 50 | 13 |
| Age from 51 to 60 | 19 |
| Age more than 60 | 8 |
| Highest leucocyte count | 47,700 |
| Lowest leucocyte count | 5,200 |
| Average leucocyte count | 17,300 |
| Leucopænia (leucocytes below 8,000) | 4 cases |
| Marked variation in leucocyte count | |
| Case 191574 (acute, 1 week) | from 11,000 to 29,000 |
| Case 262217 (time not given) | from 9,0 0 to 26,000 |
| Case 281706 (insidious onset) | from 12,600 to 47,000 |
| Case 309608 (in 1¼ years) | from 9,400 to 21,000 |
| Case 192433 (acute, 10 days) | from 15,400 to 34,800 |
| Case 125446 (death in 9 weeks) | from 15,000 to 24,300 |
| Highest weight loss | 96 pounds |
| Lowest weight loss | 10 pounds |
| Average weight loss | 33 pounds |
| Average duration of symptoms 4½ months. | |

TABLE VI.—SUBDIAPHRAGMATIC ABSCESSES FOUND AT NECROPSY: THIRTY-ONE CASES

| | | | |
|---|---|---|---|
| Males | 18 | Leucocytosis | |
| Females | 13 | Lowest count | 8,200 |
| | | Highest count | 42,000 |
| Age | | (varied from 14,800; onset of disease insidious; patient died in 39 days) | |
| Under 11 | 0 | Average count | 17,400 |
| 11 to 20 | 1 | | |
| 21 to 30 | 0 | | |
| 31 to 40 | 5 | | |
| 41 to 50 | 8 | Time between final operation and death | |
| 51 to 60 | 11 | Shortest | 0 days |
| Over 60 | 6 | Longest | 63 days |
| | 31 | Average | 22 days |

the right posterior intraperitoneal abscess may not greatly alter the position of the liver and may even push it up. The etiology, the nature and location of the pain, the tenderness, and the position of the mass, if present, serve fairly clearly to determine the position of the abscess. In considering the location, it must, as previously pointed out, be borne in mind that with the suspensory ligament as the dividing line, abscess of hepatic, appendiceal, or duodenal origin usually forms to the right, and one from perforation of the stomach, or from infection of the spleen and pancreas, forms to the left. Although the majority of these abscesses are probably single at first, frequently in late cases they are multiple, and a single abscess is very often multilocular.

### COURSE AND COMPLICATIONS

The abscesses may resolve, or may burst into the lungs, into the pericardium, into the stomach and be vomited, into the colon or duodenum and be evacuated in the stool, or through the skin anteriorly; or they may perforate into the retroperitoneal tissue and burrow extensively, even reaching the posterior cul-de-sac in the pelvis.

It is difficult to know what percentage of subphrenic abscesses resolve and are absorbed. Resolution may occur early in certain cases that are in the more or less potential abscess formation stage. In those that have developed sufficiently to be recognized by the general group of symptoms, it is rare to see resolution and absorption. Thoracic complications, such as pleurisy, empyema, abscess of the lung, bronchial fistula, pericarditis, mediastinitis, and so forth, develop in a fairly high percentage of protracted cases. In 56 of 76 of Barnard's cases, there were thoracic signs, and in 140 of 173 cases (82 per cent) collected by Laing.

Rupture of the abscess through the diaphragm into the lung is not uncommon. Within the last year I have seen one following a gastric ulcer that perforated through the diaphragm into the lung. The contents were spat up and the patient recovered without interference. I have seen one case recently in which bilateral subphrenic abscesses, both apparently extraperitoneal, ruptured through the diaphragm on both sides into the lungs, and the contents were spat up. A third case was observed in which a subphrenic abscess, due to a degenerating hydatid cyst of the liver, also ruptured through the diaphragm into the bronchus, and pus with small daughter cysts in it was spat up.

Although rupture into the stomach is fairly common, rupture into the intestine is rare. This can readily be understood as the intestine seldom comes in contact with the abscess, either the stomach or liver interven-

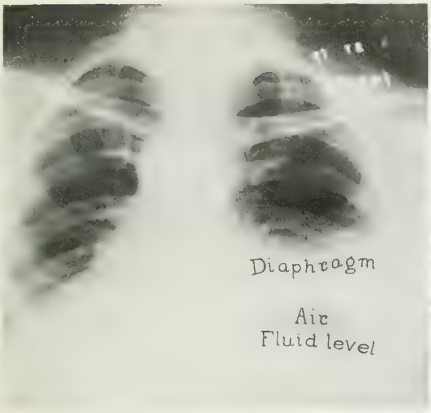


Fig. 6 (192433). Subdiaphragmatic abscess.

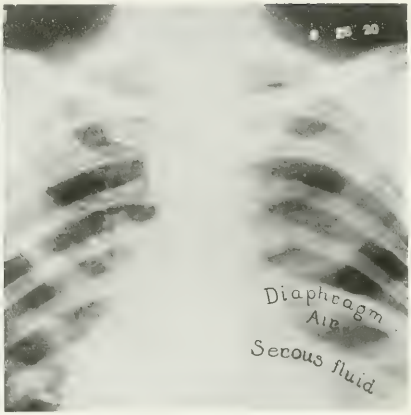


Fig. 7 (324430). Subdiaphragmatic abscess.

ing. The dread of these abscesses rupturing into the general peritoneal cavity and "lighting up" peritonitis is unwarranted, as this is extraordinarily rare.

On the whole, in less than one-third of the neglected cases, the abscesses either resolve or open spontaneously. Death occurs from toxæmia and the general weakness and inanition.

### PROGNOSIS AND MORTALITY

The prognosis in these cases must be guarded, and this again depends on the duration of the abscess, the etiology, the location, and the general resistance of the patient. Between 85 and 100 per cent of all patients not operated on die. Death has been reported in approximately 56 per cent of all patients operated on and not operated on. From 23 to 40 per cent of those operated on have died. The mortality rate should be approximately 16 per cent. A small percentage have died during operation or within a few hours after, probably because of extreme weakness before coming to operation. The greater number of deaths after operation, however, has been due to incomplete drainage of the abscess. A certain percentage of deaths is inevitable because the patient with this type of disease frequently comes to the surgeon too late, and in spite of complete drainage of the abscess, the general infection causes death.

Careful necropsies and a study of necropsy findings have established beyond doubt that in the great majority of fatal cases, in which operation was performed, drainage was incomplete. At operation there has not been sufficient exposure of the abscess to reach all its ramifications. Very often a second abscess has been entirely overlooked; not infrequently the abscess was not located at operation (Table IV).

### TREATMENT

The treatment of subphrenic abscess, when recognized, has been operative. The operation generally practiced has been either transpleural with resection of the eighth, ninth, or tenth ribs, or the surgeon has approached the abscess by an abdominal incision. The abdominal route is necessary for the left interior intraperitoneal abscess, and for the left posterior intraperitoneal abscess, but the latter should be approached only from in front and drainage established from behind.

The extraperitoneal abscesses and both right intraperitoneal abscesses can best be dealt with through a lateral thoracic incision. There are certain objections to the old operation of rib resection, namely, unneces-

TABLE VII.—ETIOLOGY IN EIGHTY-TWO CASES DIAGNOSED SUBPHRENIC ABSCESS

| | Cases |
|---|---|
| Diseased appendices | 19 |
| Longest duration of symptoms 2 years. | |
| Shortest duration of symptoms 6 weeks. | |
| Average time of onset 10 months. | |
| Drained | 11 |
| Gangrenous, removed | 2 |
| Gangrenous, no operation | 1 |
| Diseased gall-bladders | 23 |
| Longest duration of symptoms 3 years. | |
| Shortest duration of symptoms 3 weeks. | |
| Average time of onset 10 months. | |
| Empyema of gall-bladder | 3 |
| Ruptured | 4 |
| Malignant | 1 |
| Perforated duodenal ulcers | 6 |
| Longest duration of symptoms 2 years. | |
| Shortest duration of symptoms 2 weeks. | |
| Average time of onset 5 months. | |
| No operation | 1 |
| Gastric ulcers | 5 |
| Longest duration of symptoms 3 years. | |
| Shortest duration of symptoms 6 days. | |
| Average time of onset 10 months. | |
| Cancer of stomach (time of onset 3 months) | 1 |
| Hydatid cyst (time of onset not given) | 1 |
| Colectomy (time of onset 4 weeks) | 1 |
| Focal infections | 12 |
| Prostatectomy, 1 month before coming to Clinic. | 1 |
| Tonsillectomy, followed by pyæmia, 6 months before coming to Clinic | 1 |
| Amputated leg, gangrenous, time not given | 1 |
| Carbuncle, 1 month before coming to Clinic | 1 |
| Pneumonia with pleurisy, time not given | 2 |
| Influenza, 3 weeks to 2 years before coming to Clinic | 3 |
| Mediastinal abscess, 3 weeks before coming to Clinic | 1 |
| Abscess of abdominal wall following removal of bladder stone, 2 months before coming to Clinic | 1 |
| Perinephritic abscess, 8 weeks before coming to Clinic | 1 |
| Miscellaneous (not clearly determined) | 13 |

sary mutilation of the bony wall of the chest and tying off intercostal vessels, injury to the intercostal nerves, and so forth. Few surgeons are bold enough to take out sufficient rib (from 10 cm. to 15 cm.) to permit thorough inspection of the subphrenic spaces, or to allow thorough and complete drainage subsequently. Osteomyelitis and periosteitis frequently develop in the remaining portions of the rib, establishing chronic fistulæ which are usually extremely difficult to cure by any means. Particularly in well developed and fleshy patients the ordinary incision exposes large, fresh muscle surfaces, and fascial planes and fat for the absorption of the pus. Many of these patients show an intense reaction to this source of toxic absorption.

TABLE VIII.—ETIOLOGY IN THIRTY-ONE CASES

| | Cases |
|---|---|
| Posterior gastro-enterostomies | 6 |
| 4 duodenal ulcers. | |
| 2 gastric ulcers. | |
| Pyloric resections (one patient had cholecystectomy for stones) | 2 |
| Nephrectomy (patient also had duodenal fistula) | 1 |
| Anterior Pólya for gastric ulcer | 1 |
| Cholecystectomies | 6 |
| 1 patient had herniotomy and excision of duodenal ulcer. | |
| 4 patients had appendectomies. | |
| 1 patient had posterior gastro-enterostomy. | |
| Choledochotomies | 4 |
| 1 patient had cholecystectomy. | |
| 1 patient had cholecystostomy and an acute condition of the appendix. | |
| 1 patient had an acute condition of the appendix and a right salpingitis. | |
| Second-stage Kraske | 1 |
| Cæcostomy for acute obstruction. Mikulicz 1 month later | 1 |
| Subacute retrocæcal appendix | 1 |
| Empyema (abscess) | 1 |
| Ascites (later splenectomy) | 1 |
| Burns, with multiple abscesses | 1 |
| Perforation of large bowel | 1 |
| Unresolved pneumonia | 2 |
| Prostatectomy | 1 |
| Abscess of the appendix (patient had ruptured pus tube with drainage) | 1 |

Three patients had acute appendicitis with retrocæcal abscesses that probably extended to produce right posterior intraperitoneal abscesses.

In view of the foregoing objections to the old operation, and particularly since the cause of death is, as stated, incomplete drainage, or the overlooking of other abscesses, I have employed for 5 years, in abscesses located on the right side, the operation which in detail is as follows.

### TECHNIQUE OF OPERATION

After the abscess has been located as accurately as possible, the height of the diaphragm and the extent of its lateral attachment are noted; the incision is planned for either the ninth, tenth, or eleventh right intercostal space. The patient is given one ampule of pantopon and scopolamine 1½ hours before operation and one-half of an ampule of pantopon (Roche) 45 minutes later. Paravertebral anæsthesia with 1 per cent novocaine is employed and the nerves are injected two spaces above and below the space to be incised. Gas and oxygen are at hand if the patient unduly complains during the manip-

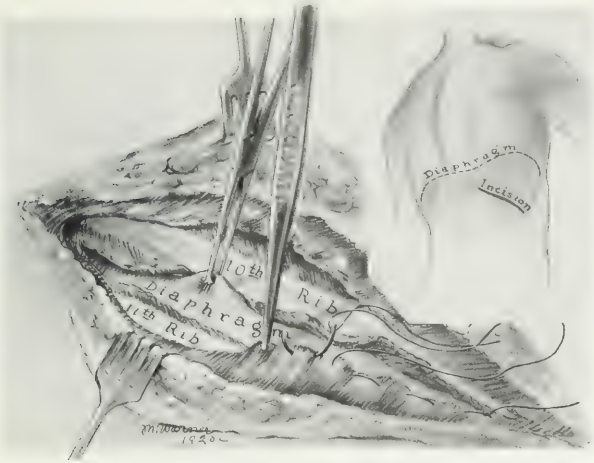


Fig. 8. Suturing of the muscles to the diaphragm. The incision is in the tenth interspace.

ulations within the abscess. An incision is made in the skin, from 16 to 20 centimeters in length, directly over the interspace and over the area of bulging, if present; otherwise it extends from the middle or posterior axillary line forward. The skin is undermined for from 3.75 to 5 centimeters back from the incision. The incision through the intercostal muscles passes about 1 centimeter above the upper border of the lower rib, so that no intercostal vessels or nerves are involved. The parietal pleura with the diaphragm firmly adherent to it is separated from the rib above and from the rib below the incision. A spreading retractor is then inserted and the interspace is forced open sufficiently freely to admit the hand. The retractor is then withdrawn and the cut edge of the muscle with the pleura is sutured to the diaphragm with chromic catgut; the diaphragm is brought out as far as possible through the interspace with suitable traction forceps (Figs. 8 and 9).

The skin, which has been freely undermined, is then sutured to the diaphragm with catgut, over the first layer of sutures, so as to shut off completely the intermuscular and fascial planes. The patient may then, if preferred, be sent back to bed and the diaphragm be opened in from 24 to 36 hours, when the muscles and skin have become completely adherent to the diaphragm, or, the diaphragm can be incised at once (Figs. 10 and 11).

In the majority of cases, after smearing the suture line with sterile vaseline, it is safe to open the diaphragm at once. After the diaphragm is opened sufficiently to admit the hand it should first be ascertained that the general peritoneal cavity is walled off completely from the abscess (it usually is); the

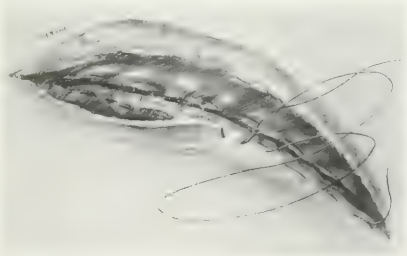

Fig. 9. Suturing the skin over the cut muscle edge to the diaphragm.

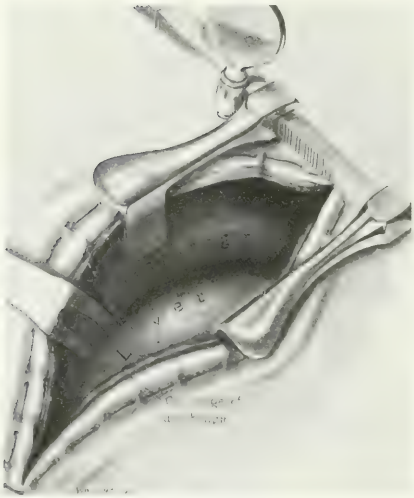

Fig. 10. Retraction of diaphragm showing space between it and the liver.

liver, the stomach, the transverse colon, and omentum, as a rule, completely wall off the abscess. Care should be taken not to destroy these adhesions. After carefully clearing out all the abscess area and swabbing the cavity dry, a separate piece of iodoform gauze is packed along the adhesions, separating off the general peritoneal cavity, and a small separate piece is packed over the posterior angle of the incision to promote granulation and protect that angle from breaking through into the thorax. A lighted retractor is used carefully to inspect the entire abscess in order to avoid overlooking a pocket or a second abscess. The parts are palpated to make sure that there is not an underlying liver abscess. Finally the cavity is swabbed with ether and a two-way catheter

TABLE IX.—OPERATIONS IN THIRTY-ONE CASES

| | |
|---|---|
| Two operations (gastro-enterostomy followed in eight days by jejunostomy) | 6 |
| Three operations | 2 |
| Operations for other conditions, without relief, subdiaphragmatic abscess overlooked | 6 |
| Emergency cases, bad risks, patients died within from 3 to 14 days | 7 |

Fig. 11. Opening in the diaphragm.

drain wrapped with iodoform gauze is placed so that it reaches the deepest part of the abscess cavity. The adjacent skin edges are draped with vaseline gauze. The patient is returned to bed and placed in a half sitting posture inclined to the right. The long end of the two-way drain protrudes through the dressing, and 1 ounce of saline is passed through the tube three times a day to clear it for drainage. On the second day the dressing is changed down to the vaseline gauze, which is not disturbed. On about the sixth or eighth day the patient is returned to the operating

TABLE X.—ONSET IN THIRTY-ONE CASES

| | Average time from onset to death | Cases |
|---|---|---|
| Insidious with acute exacerbation... | 18 days | 10 |
| 1 9 months' history, with perihepatic abscess followed by rupture of colon. | | |
| 1 6 months' history. | | |
| 1 7 months' history. | | |
| 1 12 months' history. | | |
| Acute | 13 days | 9 |
| Insidious | 33 days | 12 |
| 1 history of 18 months, after ruptured pus tube. | | |
| 1 history of 13 months, after acute appendicitis or ruptured pus tube. | | |
| 1 history of 4 months following extensive burns on arm. | | |

TABLE XI.—APPROXIMATE POSITION IN EIGHTY-TWO CASES OF SUBPHRENIC ABSCESS [1]

| | Cases |
|---|---|
| Right anterior intraperitoneal | 10 |
| Left anterior intraperitoneal | 12 |
| Right posterior intraperitoneal | 16 |
| Left posterior intraperitoneal | 6 |
| Right extraperitoneal | 4 |
| Left extraperitoneal | 5 |
| Location not clearly defined in reports | 29 |
| **COMPLICATIONS** | |
| Empyema (1 double) | 11 |
| Mass | 15 [2] |
| Gas | 5 |
| Lung abscesses | 3 |
| Perforation of diaphragm | 4 |
| Liver abscesses | 11 |
| Operation with wrong diagnosis | 4 |

[1] The exact positions were not stated in many cases.

[2] Mass or bulging noted in only 15 cases but undoubtedly was present in a much higher percentage. Same applies to gas.

TABLE XII.—APPROXIMATE POSITION IN THIRTY-ONE CASES OF SUBPHRENIC ABSCESS

| | Average time patient lived after operation | Cases |
|---|---|---|
| Right anterior intraperitoneal | 19 days | 9 |
| 3 acute | | |
| 3 insidious | | |
| 3 insidious with acute exacerbation | | |
| Left anterior intraperitoneal | 25 days | 10 |
| 1 acute | | |
| 5 insidious | | |
| 4 insidious with acute exacerbation | | |
| 1 also right anterior intraperitoneal | | |
| 1 also right posterior intraperitoneal | | |
| 1 also pelvic abscess | | |
| Right posterior intraperitoneal | 15 days | 6 |
| 3 acute | | |
| 2 insidious | | |
| 1 insidious with acute exacerbation | | |
| 1 also retrocæcal and pelvic abscess | | |
| Left posterior intraperitoneal | 13 days | 3 |
| 2 acute | | |
| 1 insidious with acute exacerbation | | |
| 1 also left extraperitoneal | | |
| Right extraperitoneal | 38 days | 1 |
| 1 insidious | | |
| Left extraperitoneal | 21 days | 2 |
| 1 insidious | | |
| 1 insidious with acute exacerbation | | |
| 1 also had right extra | | |

room, gas is administered if necessary, and the drain and all the packing are removed. The cavity is thoroughly swabbed with saline, and inspected. A lighted retractor is used in inspecting the cavity. The wound is packed with glycerin and saline (5 per cent), and a shorter two-way catheter is left in position until the cavity is gradually closed. As early as possible the edges of the incision are drawn together with adhesive strips. Too frequent changing of the deep dressing should be avoided; it serves only to destroy the young granulation and to excite an increase of temperature. Forced feeding, alkalinization (120 grains sodium bicarbonate every 24 hours), glucose, and fresh air help to restore the patient. In many of these cases in which the abscesses have been well walled off and thoroughly dealt with at the first operation, it has been possible to resort to partial secondary suture on the eighth or tenth day. The advantages of this operation are:

1. Unnecessary mutilation of the wall which is involved in rib resection is avoided, thereby the possibility of osteomyelitis and periosteitis, so frequent a sequela of rib resection in the presence of pus, is also obviated.

2. A free exposure is made to allow easy access to the subphrenic spaces.

3. The minimum of fresh tissue is exposed to re-infection.

4. Primary or secondary hæmorrhage from intercostal vessels does not occur because the vessels are not approached, and hæmorrhage from the diaphragm has been controlled by the double layer of sutures.

5. The prolonged painful dressing of a superficially granulating surface is avoided.

From a careful study of the literature and of the cases represented in the tables, certain general conclusions seem warranted (Tables V to XIII).

## CONCLUSIONS

1. Subphrenic or subdiaphragmatic abscess is a grave condition and causes a high mortality. The convalescence of patients who recover is long, tedious, and accompanied by serious complications, such as renal and thoracic lesions which often leave the patient in chronic invalidism.

TABLE XIII.—COMPLICATIONS IN THIRTY-ONE CASES

| | Cases |
|---|---|
| Perinephritic abscess | 3 |
| 1 left extraperitoneal, with perforation of colon. | |
| 1 right extraperitoneal, with perforation of duodenum. | |
| 1 right and left extraperitoneal. | |
| Liver abscess | 3 |
| 2 with multiple foci. | |
| 1 with single focus. | |
| Lung abscess | 2 |
| Perforation of diaphragm | 2 |
| Empyema | 7 |
| 3 bilateral. | |
| 4 single. | |
| Pericarditis | 2 |
| General septicæmia (clinical diagnosis) | 3 |
| Peritonitis (varying amount of serofibrinous or fibrino-purulent exudate) | 7 |

2. The serious sequelæ of the disease are due to the fact that the condition is not recognized sufficiently early, or is not dealt with promptly and completely.

3. The condition is secondary to infection elsewhere, and a high percentage of cases follows upper abdominal infection at operation or postoperatively.

4. Gravity accounts for the selection of the subphrenic area in the development of the abscesses following abdominal soiling.

5. Every effort should be made to prevent soiling of the subphrenic area during upper abdominal operations, and drainage, particularly of the upper abdomen, should be employed only when absolutely essential.

6. Subphrenic abscess should be suspected in all patients, who, following abdominal operations, maintain for no obvious reason, an elevation of temperature and pulse.

7. X-rays should be employed as an early diagnostic aid.

8. Needling for diagnosis is a dangerous practice, and should be used only to rule out pleural effusions. The needle should not be passed through the diaphragm into the abscess until the patient is on the operating table, then if pus is located, the needle should be left in position and the operation carried out without delay.

9. More deliberate and protracted operations can be performed with minimum risk to these emaciated and seriously ill patients under paravertebral anæsthesia, than under general anæsthesia.

10. A wide exposure of the abscess area is necessary.

11. Efficient drainage must be secured.

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# THE TREATMENT OF TUMORS OF THE BLADDER WITHOUT LOCAL EXCISION

An Experimental and Clinical Study

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DURING the last 10 years the treatment of tumors of the urogenital tract and particularly tumors of the bladder has received serious consideration by the urologist. This study has been stimulated by the fact that, despite our advances in surgical technique, the results following excision of tumors of the bladder have been far from brilliant. As recently as May, 1920, Lower said: "Undoubtedly the most difficult outstanding problem in genito-urinary surgery is the treatment of malignant tumors of the urinary bladder." Aside from the disposition of the benign papillomata by fulguration, the results have been most discouraging. This is true of carcinoma and papillary carcinoma and is especially true of those malignant tumors that involve the ureteral ostium.

During the last 3 years there have appeared in American literature papers by our foremost urologists, and all seem to agree that wide and clean excision offers the best method in the treatment of malignant growths. When such excision is impossible, the actual cautery has been applied in many instances with some degree of success.

Geraghty says: "It is of interest to note that the use of radium alone has not diminished the tendency of bladder tumors to recur, recurrences being observed in about 30 per cent of cases treated."

Rhodenburg and Prime have shown that tumors treated with a low degree of heat produced by diathermy or radiation alone, show but little inhibition or recession in growth when compared to tumors treated by a combination of both these agents. These authors conclude that low degrees of heat applied for varying periods of time have a lethal action on neoplastic cells *in vitro* and, with proper dosage, is effective in 100 per cent of the cases. Histological examination of tumors which have been treated by diathermy reveals cellular changes similar to those observed in tumors exposed to radiation.

James B. Murphy and E. Sturm showed that it is possible to inhibit the growth of cancer in rats, experimentally, by low heat generated by lamps.

So little has appeared in American literature concerning diathermy, that it seems pertinent to give a brief résumé of its history.

## HISTORY OF DIATHERMY

Most urologists are familiar with the d'Arsonval current. Its method of production and application to tumors under the name of electrical coagulation or desiccation is well known, but few realize that diathermy is absolutely the same thing — many times stronger in its depth of penetration but with a more balanced control.

Professor Zimmer, of Paris, has defined diathermy as a form of thermotherapy which utilizes electrical energy for the production of thermal effects in the depths of the tissues.

In 1907, at Dresden, Franz Nagelschmidt, of Berlin, demonstrated with his own instrument the "heating through" of tissues by high frequency currents. He was the first in England to demonstrate the use of diathermy in the treatment of cancer, having done so in Mr. Harmer's clinic, at St. Bartholomew's. Consequently, Mr. Harmer may be said to be the pioneer of this method in England.

In 1910, Eugene Doyen presented to the International Congress of Physiotherapy an account of the treatment of cancer by means of electrically produced heat.

In 1919, Norman Patterson, writing on the treatment of malignant neoplasms of the larynx says: "No excision of a carcinomatous growth in the tongue, mouth, or pharynx, however small that growth may be, should be carried out with the knife if diathermy is

available." He makes no mention, however, of a combination treatment with radium.

Turner, with Iredell, advocates diathermy in the treatment of malignancies. Turner demonstrated the method before the Royal Society of Medicine, London, 1919.

Harrison is in accord with Patterson's views in regard to treatment by diathermy applied in diseases of the pharynx. According to Pfender, electrocoagulation is the most valuable adjunct to X-rays in the treatment of cancer of the skin, lip, tongue, tonsils, pharynx, larynx, cervix uteri, and rectum.

During the last few years, Gustav Kolischer has been an ardent advocate of the use of diathermy followed by radium, and at the meeting of the American Urological Association in Chicago, in 1918, he demonstrated the application of diathermy to a carcinoma of the bladder. The apparatus used at that time was one of special design. He has not only advised the early application of diathermy to neoplasms of the bladder but he has included in his treatment malignant tumors in other parts of the body.

Recently, Claude Saberton published a treatise on *Diathermy in Medical and Surgical Practice*, in which he gives a complete description of its origin, methods of application, and clinical results together with an excellent bibliography.

At the present time, there are available two large instruments manufactured by the Victor Electric Company and the Wappler Electric Company respectively. Among the English instrument makers, there are available several varieties of electrodes, but in this country we have been obliged to have our own special electrodes made to order. Of course, the electrodes vary according to the nature of the tumor, its site, and the method employed in its destruction.

In consideration of the work that has been done in the treatment of bladder tumors and as a result of the experiments described in the following, it seems possible to make malignant tumors of the bladder as easily accessible as cutaneous cancers, both for postoperative observation and for the application of radium.

Experimental work on dogs shows how easily the ureteral wall can be "burned back" by means of diathermy. The offering of this method as a possible substitute for any cutting procedure is presented in the following experiments and also in a later paragraph.

### EXPERIMENTAL DATA

(With the assistance of Dr. Vincent J. O'Conor)

The degenerative and regenerative changes brought about by the action of diathermy on the bladder wall were studied in a series of five dogs. This study was undertaken for the purpose of determining the extent and character of the reaction and the type of subsequent scar-tissue formation, when the normal bladder wall of the dog had been subjected to electrocoagulation.

Direct "burning back" of the intramural portion of one ureteral wall was accomplished in three animals.

The dogs were anæsthetized with chloroform and placed upon a thoroughly insulated operating table. All operative procedures were carried out under strictly aseptic technique.

One ampere of diathermic current was used in the electrocoagulation. The bladder was opened in the median line and the trigone and ureteric orifices exposed. The slow coagulation process was then applied to the bladder wall, trigone, or the area about the ureteric orifices. The inactive electrode was placed beneath the lower lumbar region.

### RESULTS OF EXPERIMENTS

*Experiment 1.* A medium-sized mongrel bitch was operated upon February 10, 1921. One ampere of diathermic current was applied to the bladder wall, over an area 1 inch square, for 30 seconds.

The immediate effect was a slow coagulation, or a "cooking through," of the tissue so that it became ischæmic, slightly contracted and slate colored. Desiccation took place without any apparently violent reaction in the tissues and the electrode was removed at the first sign of withdrawal of fluid from the tissue; that is, as soon as "bubbling up" occurred at the edges of the electrode. After removal of the electrode, the edges of the diatherminized tissue were seen to be slightly charred, in contrast to the markedly necrotizing effect produced by the unipolar current or actual cautery.

Fig. 1. Specimen of a diathermy burn of the bladder of a dog sacrificed on the second day. Microscopically the submucosa and muscularis show extensive polymorphonuclear and lymphocytic round-celled infiltration and a small amount of extravasated blood.

Forty-eight hours later, the dog was sacrificed. The bladder wall about the coagulated area was slightly œdematous and hyperæmic, while the area itself was puckered and bloodless. The edges were black and necrotic and a slough was beginning to form. The area was somewhat indurated throughout the entire thickness of the bladder wall, but there were no adhesions outside of the bladder. Microscopically (Fig. 1) this area shows complete destruction of the mucosa, submucosa, and more superficial muscle layers. The submucosa and muscularis show extensive polymorphonuclear and lymphocytic round-celled infiltration and a small amount of extravasated blood. The line of demarcation between the diatherminized tissue and the surrounding normal tissue was very sharply defined. The area of coagulation, however, spreads in a cone-shaped manner as the deeper structures are reached.

*Experiment 2.* On the same day, a similar experiment was conducted and the dog was sacrificed on the eleventh day after diathermy had been applied to the bladder wall. The superficial sloughing mass over the burned area had almost completely separated leaving a clean, "healthy" granulating surface. The reaction and œdema in the surrounding structures had disappeared. There were a few filmy adhesions between the posterior bladder wall and the rectum. Otherwise the bladder was mobile and normally contractile.

Microscopically (Fig. 2) the superficial structures show a marked round-celled infiltration, no vascularity or extravasated blood, and the upper layers of muscle bundles show a slow, long-standing degeneration with loss, or disintegration of the nuclei. The more superficial muscle bundles are poorly stained and show degeneration.

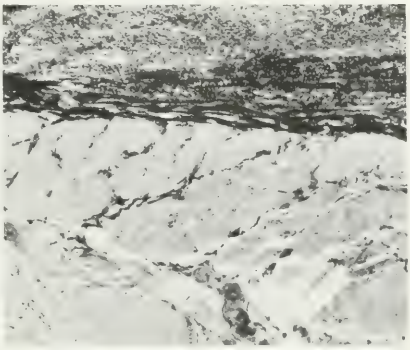


Fig. 2. Specimen of a diathermy burn of the bladder of a dog sacrificed on the eleventh day. Microscopically the superficial structures show a marked round-celled infiltration, no vascularity, or extravasated blood. The upper layers of muscle bundles showed a slow, long-standing degeneration with loss or disintegration of the nuclei. The more superficial muscle bundles are poorly stained and show degeneration.

*Experiment 3.* On November 14, 1920, a full-grown collie bitch was operated upon under chloroform anæsthesia. A suprapubic cystotomy, followed by the application of diathermy to the right intramural segment of the ureter, was done. The ureter was "burned back" over its entire visible extent. The dog made a complete recovery, with healing of the abdominal wound by first intention, on the fourteenth day. On April 24, 1921 (21 weeks later), the dog was sacrificed and the entire urinary tract was removed *en masse.*

*Autopsy record.* The mid-line incision was well and firmly healed by first intention. The bladder appeared slightly contracted. There were no peritoneal adhesions over the anterior or lateral surfaces of the bladder. Posteriorly there were a few filmy adhesions to the rectum but no fixation of the bladder. Both kidneys and ureters were normal in every respect.

The right half of the trigone (Fig. 3) was replaced by grayish firm scar tissue. The right ureteric orifice was 1.5 centimeters posterior to the normal position and the ostium, which was opened into the scar-bearing area, was not contracted or obstructed. The scar occupied the entire thickness of the bladder floor over this area.

*Experiment 4.* A full-grown Boston terrier bitch, was operated upon January 12, 1921. The operation was similar in every way to that done in the foregoing experiment. Autopsy was performed April 14, 1921, 12 weeks after operation. The kidneys and ureters were normal in every respect.

Fig. 3. Specimen of a right ureteric opening of a bladder of a dog 21 days after diathermy burn. The right half of the trigone is replaced by grayish, firm scar tissue. The right ureteric orifice is 1.5 centimeters posterior to the normal position and the ostium, which opened in the scar-bearing area, is not contracted or obstructed over this area. The scar occupies the entire thickness of the bladder floor.

There were several fine adhesions between the fundus of the bladder and the peritoneum and omentum. There were no contractions of the bladder and there were no adhesions posteriorly.

The right half (Fig. 4) of the trigone was composed of an indurated, firm, grayish white scar tissue. The ureteral opening on the right side had been burned back for a distance of 2 centimeters and was still functioning normally, although it was surrounded by scar tissue and the ostium was contracted to a pin-point size. The scar tissue occupied the entire thickness of the bladder wall.

Microscopic sections (Figs. 5 and 6) of these areas showed: a sharp line of demarcation between the surrounding tissue and the diatherminized area. The latter was entirely replaced by bands of fibrous tissue, arranged both longitudinally and transversely. The formation was very thick and the bundles were closely interwoven with no intervening areolar tissue. The epithelial layers of the bladder mucosa had been replaced by stratified squamous epithelium. There were no muscle bundles present in this area except at the extreme edge of the serous

Fig. 4. Specimen of a diathermy burn of the right ureteral opening of a bladder of a dog 12 weeks after operation. The right half of the trigone is composed of an indurated, firm, grayish white scar. The ureteric opening on the right side which had been burned back for a distance of 2 centimeters was still functioning normally, although it was surrounded by scar tissue. The ostium is contracted to a pin-point size. The scar tissue occupied the entire thickness of the bladder wall.

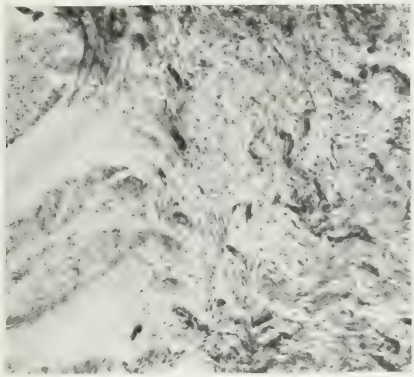
surface. The process of regeneration is one of dense fibrous tissue production with ample vascularity.

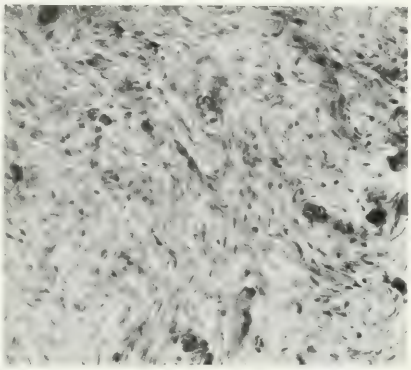
*Experiment 5.* A similar experiment was performed on January 12, 1921, on a black and white fox terrier bitch. After 12 weeks of normal activity, the dog was sacrificed on April 4, 1921. The abdominal incision had healed by primary intention. There were no adhesions about the bladder either to the rectum or the anterior parietal wall. Both ureters were normal; there was no dilatation of the renal pelvis, no atrophy of the renal parenchyma, and no signs of infection in either kidney. The bladder was slightly contracted but mobile. Otherwise, the structure was normal except that the right upper quadrant of the trigone was replaced by a smooth, grayish, fibrous tissue (Fig. 7) in the center of which the ureteral opening protruded. The orifice is 1.5 centimeters posterior to its mate. Both are normally patent.

## SUMMARY

Electrocoagulation of the normal bladder wall of the dog by diathermy is followed by distinct, uniform, tissue reaction.

The immediate effect is a slow "cooking through" of the underlying tissues, the effect upon the deeper structures being the same as that upon the mucosa. This is followed by an





Figs. 5 and 6. Microscopic sections of scar tissue taken from dog's bladder 12 weeks after diathermy burn. The areas show a sharp line of demarcation between the surrounding tissue and the diatherminized area. The latter is entirely replaced by bands of fibrous tissue arranged both longitudinally and transversely.

aseptic death of the submucosa and muscularis. Round-celled infiltration is marked only for the first three days.

Eventually, the entire area is replaced by a dense proliferation of fibrous tissue, the line of demarcation between the treated area and the surrounding normal tissue being definitely preserved.

The ureteral wall may be "burned back" in the dog almost to the entrance of the intramural portion. The results in three dogs under observation for from 3 to 5 months have shown no derangement of function in the ureteral activity or the contractility of the bladder. No obstruction to the ureteral outflow occurred in 5 months.

## DIAGNOSIS

In order to effect a cure in vesical cancers, an early diagnosis is imperative. We all know that the first cardinal symptom of neoplasm of the bladder is hæmorrhage. If the laity and the medical profession at large could only realize that hæmaturia is an even more dangerous symptom than hæmoptysis, more tumors would be recognized early, treatment instituted, and the prognosis rendered more favorable thereby. Unfortunately, this important symptom is not evaluated in its true significance.

*Diagnostic excision.* The practice of excising a piece of tumor for diagnosis has been in vogue for many years. It made no difference whether the tumor originated in the bladder, uterus, or breast, the main idea was to make a diagnosis, with little thought that the prognosis might be jeopardized by this untimely excision of tissue.

We are all familiar with the controversy that has arisen at times with pathologists over the malignancy or non-malignancy of a given tumor, because the portion removed may show none or very few malignant changes while the remainder of the tumor may be definitely cancerous.

The prevention of metastasis should ever be in mind in the treatment of tumors of the bladder. It is best not to attempt to excise a piece of tumor when the mere excision may be the cause of a transplantation metastasis. If it becomes necessary to excise tissue for diagnosis, the cautery method should be used.

Personally, I believe that in tumors of the bladder, it makes very little difference, so far as the clinical course is concerned, whether a piece is taken for diagnosis or not. In the large majority of cases, cystoscopy, palpation, and X-ray examination, if intelligently performed, give all the positive information that is necessary.

Fig. 7. Specimen of a diathermy burn of the right ureteric opening of a dog's bladder 12 weeks after burn. The right upper quadrant of the trigone is replaced by smooth, grayish, fibrous tissue in the center of which the ureteric opening protrudes. The orifice is 1.5 centimeters posterior to its mate. Both are normally patent.

*Cystoscopy.* We have been taught that all the papillomata are potentially malignant and that this malignancy increases as age advances. While this is true in a measure, we must not lose sight of the fact that malignancy appears in the young as well as in those of more advanced years.

It is impossible, in those cases that present themselves early for cystoscopic examination, to determine whether the papilloma is benign or malignant. Unfortunately, many cases come for examination when the malignant changes are advanced and infiltration of the bladder wall has occurred. It is at this period that cystoscopy will often disclose all we need to know, while a biopsy performed at this time is only of scientific interest and may be a dangerous procedure.

The salient features of a malignant neoplasm of the bladder, as viewed through a cystoscope, are:

1. The changing of a papillomatous tumor into a sessile growth;

2. Early necrosis or erosion of the tumor mass that has not been fulgurated;

3. Presence of accessory tumors slightly adjacent to a central tumor, which may or may not be associated with bullous œdema;

4. In the absence of a positive source of infection, the presence of a severe cystitis. This condition, associated with a bladder tumor is often indicative of malignancy.

*Palpation.* The palpation of tumors situated in the bladder through the abdominal wall is difficult. Occasionally, however, when the tumor involves the vertex, this can be accomplished with success. As at least one-half of the tumors occur on the base or lateral sides of the bladder wall, much valuable information can be obtained by rectal examination in the male. Here, the infiltration can often be distinctly palpated. In the female, the vaginal examination as a rule reveals the extent of the infiltration more distinctly than the rectal examination does in the male.

*Roentgenography.* No examination, however thorough, should be concluded without an X-ray examination of adjacent bony parts, for metastasis. If extension has occurred, the prognosis is grave and only palliative relief can be expected.

### TREATMENT

Experience has led me to believe that the treatment of bladder tumors may be classified as follows:

1. *Benign papillomata.* If there are but few papillomata and they are easily accessible, transurethral fulguration is used followed by the transurethral application of radium with a special radium applicator. It has been our custom to fulgurate papillomata, then await developments. This I believe is a mistake. As all papillomata may be potentially malignant, it seems to me that the prophylactic application of radium is an additional means to destroy a smoldering malignancy.

2. *Multiple benign papillomata and tumors inaccessible transurethrally.* We use suprapubic fulguration with diathermy followed by radium applied through the suprapubic fistula by means of the special radium applicator.

3. *Carcinoma.* These tumors are treated by the same method as multiple papillomata,

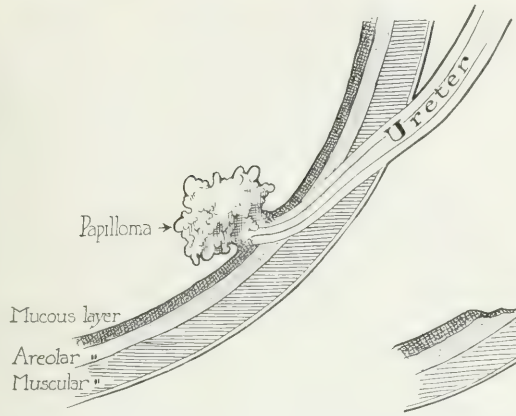



Fig. 8. Diagrammatic drawing showing ureter passing through the bladder wall; with its ostium obstructed by a papilloma.

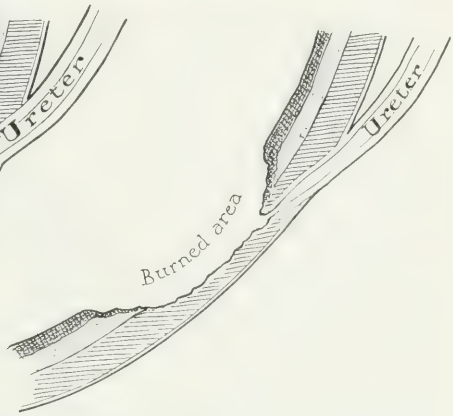



Fig. 9. The same view showing how the ureter is "burned back" by means of diathermy, including removal of the papilloma.

only the diathermy coagulation is more extensive and the radium is applied more intensively.

*4. Tumors involving the ureteral ostium.* Considerable literature has appeared relative to the treatment of the ureter when its ostium is involved in a vesical carcinoma. About 2 years ago, I had the opportunity of treating a vesical carcinoma that involved the left ureteral opening, where the neoplasm had been present for several years and where there was considerable involvement of the bladder floor as well as the ureter. Following destruction by diathermy, I was surprised, some months later, while looking into the bladder by means of the cystoscope, to find the ureter "burned back" fully an inch and to note that it was perfectly patulous and functionating.

Lower has shown how the ureter passes through the bladder wall for a considerable distance and he has devised a unique method of excising the intramural portion of the ureter when it is involved in papillary carcinoma.

As it is my desire to present a method of treating all vesical tumors without the use of any cutting procedure, the "burning back" of the ureter by diathermy is offered in place of this method of excision. This, I believe, is substantiated in view of the excellent results obtained in our experimental work on dogs and in a limited number of clinical cases observed during the past 3 years (Figs. 8 and 9).

## TECHNIQUE

The employment of diathermy in the treatment of tumors of the bladder requires a careful preparation of the operating table and the proper adjustment of the wires from the electrodes in order to avoid short circuiting.

*Preparation of operating table.* We have found it advisable to cover the table with several layers of thick paper, over which is placed ⅛-inch rubber sheeting. This must be carried well up to the head piece to insure perfect insulation of the head. Over this is placed some heavy woolen material to keep the body as dry as possible, which may be assured by using great care not to use any excessive amounts of liquids in the pre-operative cleansing of the operative field. It is well to have the operator and his assistant stand on wooden platforms that are covered with paper and rubber strips ⅛ inch thick.

The indifferent electrode consists of a piece of blocked tin about 5 by 6 inches and is placed under the patient just above the but-

Fig. 10. Illustrating the inactive and the active electrodes, the Kolischer retractor and the flat retractor all in place; with the active electrode immediately over the tumor.

tocks. Between the electrode and the patient's skin, is placed gauze that is well moistened with hypertonic salt solution, which minimizes the danger of a superficial burn. When the operation is prolonged, this gauze should be moistened in order to protect the skin under the electrode. After the operation, the site of the indifferent electrode should always be examined to see that no burning of the skin has taken place.

If a head-light is used by the operator, it is well to supply the current from a storage battery.

Great care should be used in giving the anæsthetic. Morphine and scopolamine with gas oxygen must be used, as ether anæsthesia is extremely dangerous due to possible short circuiting of the current.

The active electrode consists of a rubber handle through which a metal core passes. The cable of the diathermy machine screws into its proximal end, while electrodes of various types may be screwed into the distal end. The choice of instrument depends upon the particular situation and character of the part we are called upon to treat.

*Suprapubic operation.* Following a preliminary cystoscopy and a careful mapping out of the tumor, the patient, with the bladder moderately distended, is anæsthetized and placed in the Trendelenburg position. The suprapubic opening is made sufficiently large to insure a good view of the bladder cavity and the malignant growth.

Exposure is facilitated by the use of proper retractors. As metal is a conductor of elec-

Fig. 11. Showing the glass speculum with the insulated wire holder. The active electrode is within the speculum.

tricity, it is well to substitute rubber in its place. The large flat rubber retractor designed by Kolischer is very useful where one retractor alone is used. We have designed two flat rubber retractors that help to pull the bladder laterally and greatly facilitate the exposure of the tumor mass (Fig. 10). The use of a Barnes' bag in the rectum is a great help in exposing the field to be burned. It also acts as a shield to protect the rectal wall. In order to protect the bladder wall and the adjacent structures from extraneous burning, a glass speculum is placed over the tumor mass.

When everything is in readiness, the surgeon grasps the active electrode and passes it down the glass speculum which has been previously placed over the tumor or portion of the tumor to be burned (Fig. 11). The electrode is placed firmly in contact with tissue to be burned and the current is applied. After a time, bubbles of gas and steam are given off and cracking sparks jump from the sides of the electrode to the adjacent tissue. This is a sign that the tumor mass has been "cooked." The current should be immediately turned off to avoid making too deep a burn. If the malignant growth is extensive, it may be well to adjust the glass speculum in order to burn the mass in its entirety.

Because of the electrocoagulation, the burned tissue is hot, dry, and white in appearance, the depth of the coagulation depending upon the size of the electrodes, the amount of current used and the depth of tissue between electrodes (Fig. 12).

Having once found the established strength of current used in any particular case, the current regulator may be left in position for the next application of the electrodes. We have made a practice of permitting the suprapubic wound to heal after we have disposed

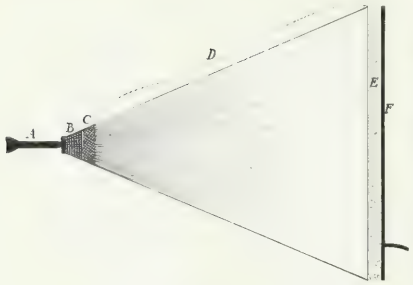



Fig. 12. Diagrammatic representation of what occurs under active electrode in surgical diathermy. *a*, One-fourth inch active disc electrode; *b*, tissues visibly coagulated to a depth approximately equal to the diameter of the disc electrode used; *c*, area of tissues in which the current density has been insufficient to cause coagulation, but has probably been sufficient to destroy the vitality of the cells; *d*, gradual diminution of current density and heating effect; *e*, thick pad of gauze saturated in warm saline solution (1 ounce salt to 1 pint water); *f*, large indifferent metallic electrode. (Reproduced from *Diathermy in Medical and Surgical Practice*, by Claude Saberton.)

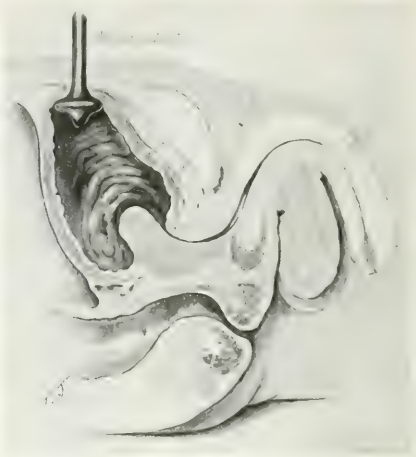


Fig. 13. Illustrating the position of the de Pezzer catheter, after cystotomy.

of the neoplasms. This, I believe, can be improved upon, for the following reasons:

Bladder tumors are less accessible once the suprapubic wound heals. With a suprapubic fistula, the possibility of making these tumors as easily accessible as cutaneous cancers is actually created by the combined cystoscopic radium applicator. The putting at rest of the bladder, during convalescence, by establishing a permanent drainage, adds greatly to the comfort of the patient and permits the inspection from time to time of the vesical cavity with a minimum of discomfort to the patient.

As the treatment of malignant tumors of the bladder is at best precarious and uncertain, it seems desirous to put the bladder in such a position that the tumor can be under constant observation for a long period of time. With this idea in mind, the bladder is closed after the method of Pilcher in making his preliminary cystotomy for prostatectomy. This permanent suprapubic fistula insures rest of the bladder, offers an opportunity for study of the tumor mass, from time to time, by suprapubic cystoscopy (thus bringing the growth under direct observation, as it were) and affords the direct visual application of radium to the tumor mass, the two latter procedures causing the patient only a minimum of discomfort (Fig. 13).

The suprapubic fistula is maintained for many months, but the de Pezzer catheter is changed only at the time of the insertion of the radium cystoscopic applicator. However, the patient is instructed to keep the fistulous tract clean by daily cleansing with hydrogen peroxide and an antiseptic.

Sodium acid phosphate and hexamethylenamine are given internally and the patient is encouraged to drink large quantities of water during the day.

The catheter may be corked with a stopper and the urine withdrawn from time to time, or the patient may be allowed to void at will; but, at night, it is well to connect the catheter with the drainage tube at the side of the bed (Fig. 14).

### ADVANTAGES OF DIATHERMY OVER CUTTING PROCEDURES

In the operative treatment of neoplasms of the urinary bladder, it is necessary in working out a technique to keep constantly in

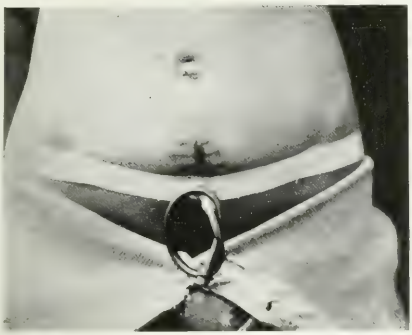


Fig. 14. Photograph of patient with de Pezzer catheter in place, the distal opening of the catheter being plugged with a cork.

mind that every step of the operation must be so planned as to avoid implanting tumor cells on raw or cut surfaces. This has been recently emphasized by Beer.

Diathermy is absolutely bloodless if a flat or blunt electrode is employed; which, if properly used, insures not only total destruction of the mass but also sufficient coagulation of the tissues in the immediate neighborhood to minimize the possibility of cell implantation.

Vascular structures situated in the near vicinity are sealed, thereby lessening the absorption of infection. Consequently, a shorter convalescence is insured.

On account of the absence of any extensive cutting procedure postoperative shock is minimized, which is of great value in operating upon patients of advanced years.

Lastly and most important of all, are the density and extent of the scar tissue that results after the employment of diathermy in treating malignant disease. The body defense against carcinoma metastasis lies in the formation of a connective-tissue capsule. The scar tissue that is formed after a diathermy burn is more dense and spreads farther into the surrounding tissue than is the case after any cutting operation. We have here then an extensive reinforcement of nature's attempt to throttle the embryonal cell.

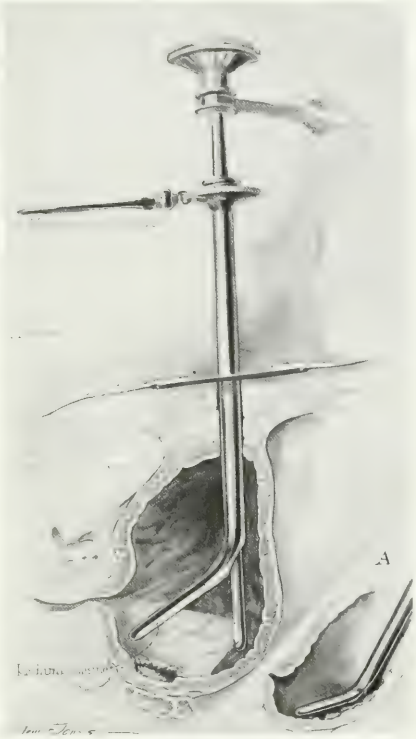



Fig. 15. Author's cystoscopic radium applicator. *a*. Shows the radium capsule lying on the tumor after withdrawal of the observation cystoscope.

### THE USE OF RADIUM

The cystoscopic radium applicator (Fig. 15), that is here illustrated, is the same as that devised for the urethra and illustrated in this journal last year, except that it is a little shorter and contains a flat shoulder at the proximal end that enables it to be fastened to the abdominal wall with adhesive tape. The nickeled radium capsule that was originally used has been replaced by one made of gold.

The amount of radiation that is required to effect a cure, if such can be expected in a given case, varies. If one expects the best

results in the treatment of these tumors the co-operation of a radiologist is advised.

It has been suggested that the radium applicator might be of service in placing the radium element over a carcinoma of the prostate, once a suprapubic fistula has been established.

I desire to acknowledge my appreciation and thanks to my associate, Dr. V. J. O'Conor, for his suggestions and assistance in the experimental work reported in this paper.

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# THE PHYSIOLOGICAL METHOD OF TENDON TRANSPLANTATION

By LEO MAYER, A.M., M.D., New York

DURING the winter of 1916 I published a series of articles in this journal describing a new method of transferring tendons. This method I termed "physiological" since it attempted to correlate each step of the operation with the known facts of tendon physiology and anatomy. The first paper gave a brief review of the research work dealing with the finer structure and the function of tendons, the second paper dealt with operative technique and the third, with the clinical results. I was able at that time to report about 200 cases operated on during my service at the Oskar-Helene Home for Crippled Children. Since the progress of these cases was sufficiently encouraging to warrant further trial of the method, I have used it consistently during the last 3 years, and with the further refinement of the technique which this additional experience has brought, the results have improved correspondingly. To the helpful criticisms of colleagues, particularly to Dr. Steindler, of Iowa City, and to Dr. Bunnell, of San Francisco, this improvement is largely due. Dr. Steindler has advised the conservation of the blood supply of the tendons wherever this is feasible, and Dr. Bunnell by devising an ingenious clamp, has applied this method to the traumatic surgery of tendons. To invite further constructive criticisms as well as to report the present status of the physiological method, it seems advisable to describe the operative technique now employed and to summarize the end-results of the last 3 years' clinical experience.

The essential function of the tendon is transmission of the contractile force of the muscle. It corresponds closely to the rope of a derrick and just exactly as the entire action of the rope would be destroyed by a single clamp which prevented it from gliding, so, too, the function of the tendon is entirely inhibited by a single adhesion. The gliding mechanism of the tendon is therefore of the utmost physiological importance and its conservation is the first requisite in all tendon operations. Strange to say, despite this self-evident fact, no experimental work so far as I know, had ever been done on this subject until Dr. Henze and I, during the winter of 1912 at the suggestion of Professor Lange, of Munich, made a study of postoperative adhesions to tendons and the methods of preventing their development. This research proved that the introduction of foreign bodies of any kind, such as vaseline, bismuth paste, etc., instead of preventing the formation of adhesions served rather to encourage them; that on the other hand by retaining the normal relationship between the tendon and its sheath (as proposed by Biesalski), the normal gliding function of the tendon could be perfectly preserved. Before this

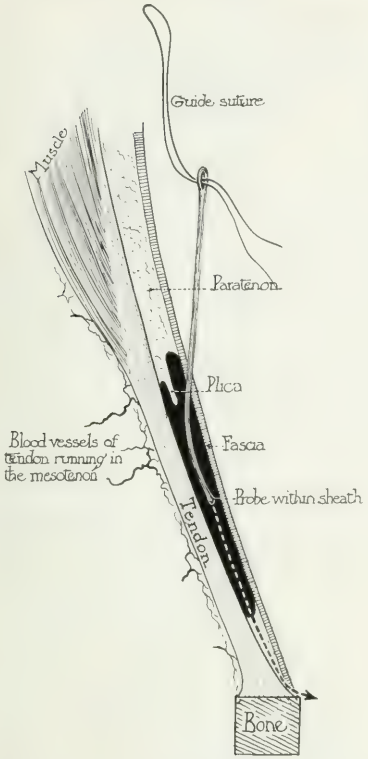


Fig. 1. Diagrammatic longitudinal section through the tibialis anticus tendon illustrating the manner of passing the probe downward through the tendon sheath. The dotted line and the arrow indicate the passage of the probe through the lower pole of the tendon sheath and out near the insertion of the tendon.

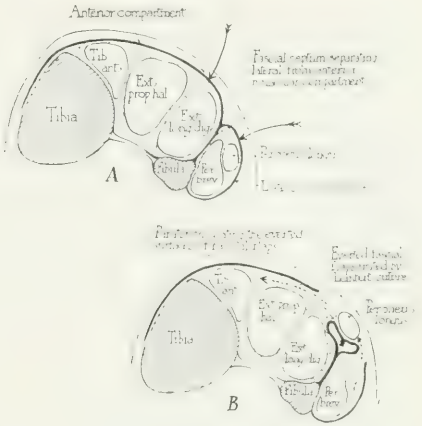


Fig. 2. Diagrammatic cross section of the calf illustrating the division into the anterior and lateral muscular compartments by a fascial septum (*a*). To transfer the peroneus longus tendon from the lateral compartment to the anterior, the fascia is incised at the points indicated by the arrows and the fascial edges are then everted and brought together by a suture as indicated in *b*. The paratenon or gliding tissue which coats the deep surface of the fascia prevents the formation of adhesions.

fact could be effectively applied to tendon transplantation on human beings, it was necessary to learn something about the gliding mechanism of tendons, a subject which, like everything else connected with the physiology of tendons, had been a closed book both to surgeon, physiologist, and anatomist. This second research, full details of which were published in the opening chapters of the volume "The Physiological Method of Tendon Transplantation" (Biesalski and Mayer), showed that the essential tissue concerned with the motion of the tendon was a very loose fatty mesh-work, rich in elastic fibers, which surrounds the tendon on all sides and because of its elasticity permits the tendon to glide to and fro beneath the rigid unyielding fascia. For this tissue I suggested the term *paratenon*. The tendon sheath is a closed sack containing fluid interposed between the tendon and the restraining fascial band or the bone at any place where the tendon changes its direction. The object of the sheath is to serve as a fluid buffer to diminish friction at this point. A sheath is not present when the tendon runs a straight course, since then the paratenon is sufficient to permit gliding. At the upper part of most tendon sheaths, there is a special mechanism termed the plica, which acts as a kind of valve permitting the free motion of the tendon and at the same time keeping the tendon sheath intact. The surface of the tendon is coated with cells differing in their histological structure from those in the deeper layer of the tendon and

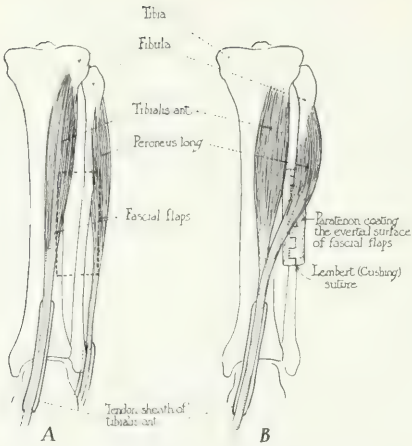


Fig. 3. Diagrams illustrating the transfer of the peroneus longus to replace the tibialis anticus. *a*, Shows the form and location of the fascial flaps which are everted to facilitate the passage of the peroneus longus from the lateral muscular compartment to the anterior. *b*, Illustrates the course of the peroneal tendon over the fascial flaps after they have been everted and united by a Lembert suture. The paratenon coating the everted deep layer of the fascia prevents the formation of adhesions.

judging by the formation of adhesions when these cells are destroyed, they seem to be particularly adapted to the gliding of the tendon. Where the tendon rubs against the bone or fascial band, these cells assume the character of cartilage cells. They are particularly poor in blood vessels, whereas the deeper layers of the tendon which are not exposed to friction are comparatively much more vascular.

The tension of tendons, as has been determined by a series of experiments on dogs as well as by careful measurements during operations on human beings, varies directly according to the strength of the muscle and the degres of its contraction, but for all muscles and all tendons one measurement remains constant: when under anæsthesia with the muscles completely relaxed, the extremity is held in such position that the origin of the muscle and the insertion of the tendon are brought as near together as possible, then the tension of the tendon is zero. For instance, if the foot is held inverted and dorsiflexed, in other words, the origin and insertion of the tibialis anticus muscle is brought as near together as possible, then the tension of the tibialis anticus tendon is zero. This fact is of easy application to all tendon operations since the operator need only hold the limb in the position indicated and suture the tendon with just enough force to render its course a straight one. In addition to the gliding mechanism and the tension of tendons, other important anatomical data were published dealing with the blood supply of tendons, the relation of tendons to fascial septa, the effect of traumatism and the relative strength of various methods of tendon suture.

Applied to tendon operations, these facts resulted in a system of operations in which the cardinal principle was the correlation of the operative technique with the known facts of tendon physiology, and in particular the retention of the normal relationship between the tendon and its gliding mechanism. There must, of course, be absolute asepsis, minimal hæmorrhage and minimal traumatism. In addition the operations must meet the following demands:

1. They must whenever possible restore the normal relationship between the tendons and the sheath.

2. The course of the tendon from its original site to that of the paralyzed tendon must run through tissue adapted to the gliding of the tendon. Injury to the periosteum or the crude boring of a hole through fascia or interosseous membrane is inconsistent with this demand.

3. The normal insertion of the tendon must be imitated wherever possible by implanting the tendon directly into bone or cartilage, preferably at the insertion of the paralyzed tendon.

4. The normal tension of the transplanted tendon must be re-established and the physiological length of the transplanted muscle thus maintained.

5. The line of traction of the transplanted tendon must be such as to enable it effectively to do the work of the paralyzed tendon.

The operations to be described in this paper fall into four groups:

Fig. 4. The author's tendon clamp.

First, tendon transplantations, or more accurately "transfers," in which the insertion of the tendon is altered.

Second, true transplants or "free" transplants, in which a portion of a tendon is removed and grafted into a new position, usually to bridge the gap between the retracted ends of a divided tendon.

Third, tendolysis to free a tendon from adhesions and prevent their reformation.

Fourth, tendon suture for traumatic division of tendons.

As the last is accurately described by Bunnell, I shall not repeat it here, but simply refer the reader to Bunnell's article in Surgery, Gynecology and Obstetrics for January, 1918. Tendolyses are now frequently done for the finger tendons, and I shall describe one such operation as typical. The free tendon graft is applicable to any site and I shall describe a typical operation for the lower and the upper extremity. My own experience has been concerned chiefly with the first group of operations, the tendon transfers, which are of the utmost importance in the treatment of the residual paralyses not only of poliomyelitis but of extensive gunshot injuries. In this group I shall describe four operations for the lower extremity, namely: for paralytic flat foot, club-foot, hollow foot, and paralysis of the extensors of the knee; and three for the upper extremity, for drop-wrist and for complete division of the flexors and extensors of a single finger.

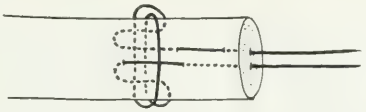

Fig. 5. The fixation suture. This is inserted by using a suture with a straight needle at each end. With the first needle, two transverse stitches are taken through the tendon and then a longitudinal which is brought out at the cut surface of the tendon. With the second needle a longitudinal stitch only is taken which emerges on the cut surface. This fixation suture will stand great tension without tearing.

## Technique in Detail

### Group I.—Tendon Transfers

*1. Paralytic flat foot.* The operation usually indicated is the transfer of the peroneus longus to replace the paralyzed tibialis anticus. The chief anatomical difficulty in the execution of the operation is the fact that the peroneus longus lies in a fascial compartment separated throughout its extent from that of the tibialis anticus. To overcome this difficulty a fascial plastic is necessary. The first step of the operation is the preparation of the implantation site for the peroneal tendon. An incision about 2 inches long bowed with the convexity toward the sole of the foot is made over the insertion of the tibialis anticus. The paralyzed tendon is exposed at its insertion, slit longitudinally for about 1 inch and the subjacent bone or cartilage of the internal cuneiform is grooved with a small gouge for the reception of the peroneal tendon. It is advisable to prepare the implantation site as the first step of the operation so as to avoid exposing the peroneal tendon to the air more than is absolutely necessary. The method heretofore commonly practiced of freeing the peroneal tendon and wrapping it up in gauze while the implantation site is being prepared, is to be condemned as unphysiological, since the gliding cells on the surface of the tendon are readily traumatized by contact with any foreign substance. It is quite essential for the successful gliding of the transplanted tendon that it be transferred from its original site to the new one within a very few minutes and with minimal handling. The

Fig. 6 (at left). Paralytic flat foot due to paralysis of the tibialis anticus and posticus.

Fig. 7. Same patient after transfer of the peroneus longus to replace the paralyzed tibialis anticus. The plano-valgus deformity has been entirely corrected.

cuneiform bone is purposely traumatized so as to encourage its osteogenetic activity. Adhesion between the tendon and the traumatized bone occurs in less than 16 days and the union by that time is sufficiently firm to permit active motion of the transplanted tendon.

The second incision about one inch long, is made near the upper pole of the tibialis sheath, about 2 inches above the tip of the internal malleolus. The sheath is opened just enough to permit the passage of a probe downward through the sheath and out at its lower extremity (Fig. 1). The tip of the probe is then seen to emerge just at the insertion of the tibialis anticus. The probe should be bent slightly near the tip and should be passed in such a way as to lie on the anterior surface of the tendon. Unless this precaution is taken, the probe has a tendency to slip off to the side and to traumatize the mesotenon or vascular membrane which connects the tendon with the floor of this sheath. Into the eye of the probe is threaded a strong silk or linen suture. The two free ends of the suture are passed through the eye so that the loop can be utilized at a later step of the operation to draw the tendon downward without the necessity of knotting. Even a small knot is bound to traumatize very much more than the smooth loop. The probe is drawn entirely through the sheath leaving the guide suture in place.

The third incision must be a long one, since the peroneal tendon must be exposed up to the middle of the calf if it is to be given the proper line of traction. A common mistake is to free the tendon only a short distance above the external malleolus thus rendering its course transverse rather than vertical. Its action under such circumstances is just the opposite of that required; it everts the foot instead of inverting it. The incision runs from the middle of the calf downward to the external malleolus, around it, and down to the cuboid bone. It is made slightly S-shaped, the upper part of the incision nearer to the tibia, the lower part near the fibula. This is done so as to facilitate the execution of the fascial plastic. The skin and subjacent tissues are retracted from the underlying fascia until not only the peroneal muscles but also the muscles of the anterior fascial compartment are visible. A longitudinal slit is made in the fascia over the anterior compartment and over the lateral compartment (Fig. 2). Depending upon the age of the patient, these openings in the fascia should be from 2 to 3 inches long. With a little practice it is easy to estimate their length correctly. At each end of the longitudinal slit small transverse incisions are made to permit the eversion of the fascia (Fig. 3). The object of this procedure is to evert the deep layer of the fascia which is coated with paratenon or gliding tissue, and over this gliding tissue the peroneal tendon can be made to pass from one fascial compartment into the other. If this were not done adhesions would almost certainly occur, since traumatism to the fascial septum, as shown both experimentally and in secondary operations, gives rise to adhesions which would impede the gliding of the tendon. The two fascial edges are united by means of a fine silk suture inserted in much the same way as the serosa stitch of a gastro-enterostomy. It is very important that the surface of the fascia coated with gliding tissue, be entirely untouched by any instrument or gauze. Only

the edge which is inverted by the stitch is grasped by the forceps. The suture itself when properly inserted, does not show at all. I have found the Cushing modification of the Lembert suture more practical than any other. Instead of tying the suture at the lower end of the fascial flap, it is advisable to take an additional stitch so as to tie at a somewhat lower point and thus avoid any possible contact of the tendon with the knot.

The eye probe must now be passed from the upper pole of the tibialis sheath beneath the fascia and out in the region of the fascial plastic. The upper end of the guide suture lying in the tibialis sheath is drawn beneath the fascia by means of the probe. The guide suture thus runs from the fascial plastic beneath the fascia cruris into the tibialis anticus sheath, downward through the sheath and out near the insertion of the tibialis tendon. It is everywhere in contact with gliding tissue and by drawing the peroneal tendon along this course, it will make its pathway correspond to the normal. Only after all these preparatory steps is the operator ready to expose the peroneal tendon. The tendon is freed by prolonging the fascial incision already made over its upper end downward until the sheath has been opened and then along the sheath to the groove in the cuboid bone where the peroneal tendon passes into the sole of the foot. It is at this point that the tendon should be divided, since experience has shown that it is then just long enough to reach to its new point of insertion. The tip of the divided tendon is grasped with the tendon clamp (Fig. 4) and a No. 2 chromic suture is inserted as indicated in Figure 5. The ends of the suture are left long to facilitate drawing the tendon downward through the sheath of the tibialis anticus. As rapidly as possible the tendon is now freed up to the lowermost muscle fibers and drawn over the fascial bridge downward through the tibialis sheath (Fig. 3, *b*). While doing this the first assistant must hold the tendon in the air by means of any smooth instrument so as to prevent the tendon from buckling. The operator must grasp the end of the tendon with a forceps and start it on its pathway, since otherwise tortion is likely to occur. This step of the operation, more than any other, requires practice and team play. Its execution ought not to require more than 5 seconds.

Fig. 8 (at left). The effect of transplantation of the peroneus longus through the sheath of the tibialis anticus in a case of severe paralytic flat foot due to paralysis of both tibialis anticus and tibialis posticus. Note the complete absence of planus deformity. Operation June, 1918; photographed July, 1920.

Fig. 9. Same patient as in Figure 8 illustrating the degree of voluntary inversion subsequent to the transplantation of the peroneus longus through the sheath of the tibialis anticus.

The long incision is closed at once to prevent further exposure of the tendon to the air, then the second incision is closed. The operator is then ready to attach the tendon to its new insertion. The ends of the chromic gut suture are passed into a stout cervix needle with which several firm bites are taken through fascia and cartilage. The fixation should be such as to draw the tendon directly against the bed in the internal cuneiform bone already prepared for it. The two halves of the split tibialis tendon are united to the tendon so as to give additional security. This method of fixation meets the demands of mechanical security and also of physiological fixation, since the traumatized bone cells react to hold the tendon secure. To determine the degree of tension under which the tendon should be sutured, the operator has recourse to the rule already referred to, namely, that when under anæsthesia the origin and insertion of a muscle and its tendon are approximated, the tension of the tendon is zero. The foot is therefore inverted and dorsiflexed and the peroneal tendon is pulled upon with just enough force to render its course straight. It will be found that its length, if it has been divided at the cuboid groove, is just sufficient to make it reach the bony implantation site prepared for it.

The operation is concluded by suturing the first skin incision. The foot is then immobi-

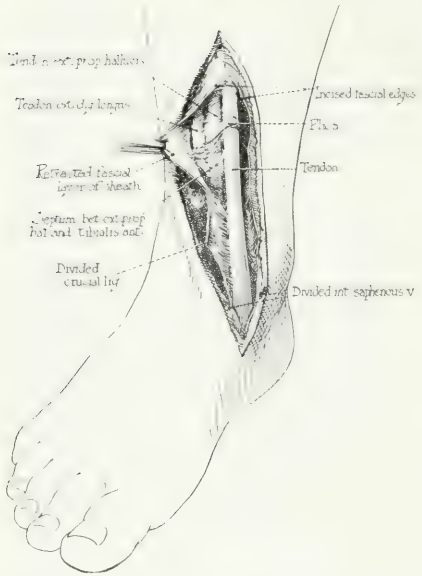


Fig. 10. Transfer of the tibialis anticus to replace the paralyzed evertors of the foot in a case of paralytic club-foot. The drawing illustrates the second incision which exposes the tibialis anticus tendon. The fascia is retracted by a clamp exposing the extensor longus digitorum tendons above their sheath. The probe inserted at this point passes downward along the tendons into the sheath of the extensor longus digitorum and out near the insertion of the peroneus tertius. (From Mayer, *Orthopedic Treatment of Gunshot Injuries.*)

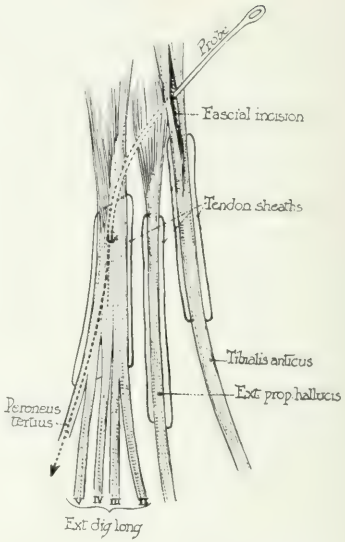


Fig. 11. Diagram illustrating the passage of the probe through the sheath of the extensor longus digitorum for the transference of the tibialis anticus to the outer side of the foot. The dotted line and the arrow indicate the direction of the probe through the sheath and its emergence at the insertion of the peroneus tertius.

lized in plaster-of-Paris in a position of inversion and dorsiflexion.

2. *Paralytic club-foot.* Transplantation of the tibialis anticus is done to replace the evertors of the foot. A horseshoe-shaped incision is made over the insertion of the peroneus tertius, the skin flap being directed upward. The tendon of the peroneus tertius is split at its insertion and a groove cut in the fourth and fifth metatarsal bones for the reception of the tibialis tendon.

The second incision is made along the course of the tibialis anticus tendon from a point slightly proximal to the upper pole of the sheath downward to its insertion. The fascia is incised just above the sheath and is retracted toward the outer side of the leg so as to expose the extensor proprius hallucis and the extensor longus digitorum (Fig. 10). An eye probe threaded with a guide suture is now passed downward along the course of the extensor longus digitorum tendons and made to enter its sheath (Fig. 11). This is a simple procedure if the operator is careful to make the tip of the probe hug the tendon. This is best done by making a small hole in the paratenon which surrounds the tendons into which the tip of the probe is inserted. On entering the sheath the probe finds its way readily downward and is made to emerge over the peroneus tertius tendon which runs through the same sheath as the long extensor (Fig. 11). The probe is pulled through bringing the guide suture after it. The tibialis anticus sheath is split open its entire length and the tendon cut away at its point of inser-

tion. Unless the full length of the tendon be secured, it will prove too short to reach to the outer side of the foot. It is advisable to take a small bit of cartilage or bone with the tendon since this renders the union at the new point of implantation particularly firm. The tendon is threaded with the usual fixation suture, freed from its mesotenon and by means of the guide suture drawn downward through the sheath of the extensor longus digitorum and made to emerge at the insertion of the peroneus tertius. Here it is fastened to the groove already made in the bone. The operation is concluded by suturing fascia and skin. The leg is immobilized with the foot in maximum eversion and dorsiflexion.

In mild cases of club-foot the extensor proprius hallucis may be used instead of the tibialis anticus. The operation is performed in exactly the same manner.

3. *Paralytic cavus* (paralysis of the gastrocnemius and soleus). Transplantation of the peroneus longus or brevis combined with that of flexor longus hallucis is done to replace the paralyzed Achilles tendon. This operation is indicated in cases of moderate cavus deformity. When the cavus deformity is marked, bone operations, either astragalectomy or the Jones operation, are necessary.

After a preliminary division of the plantar fascia, of the plantar muscles and if necessary of the long plantar ligaments, the foot is wrenched thoroughly so as to restore the normal form. Two transverse incisions are made over the back of the heel excising an ellipse the width of which is dependent on the amount of redundancy of the skin. Sufficient skin should be excised to draw the heel toward the knee with all the traction that the suture line can stand. Through the two lateral projections of this elliptical incision, the peroneal tendons are exposed on one side and the flexor longus hallucis tendon on the other.

The peronei are easily found but the long flexor of the toe lies buried beneath a fascial plane which holds it close against the groove in the astragalus (Fig. 14). The large vessels and the posterior tibial nerve should be drawn forward until this fascial band is exposed and only after its incision will the tendon become visible. The tendons are cut off as low as possible, threaded with the usual fixation suture, drawn through a slit in the Achilles tendon and fastened firmly to the os calcis which has been grooved for their reception as in the previous operations.

Fig. 12 (at left). Paralytic club-foot before treatment.
Fig. 13. Same patient as in Figure 12 one year after transplanting the tibialis anticus through the sheath of the extensor longus digitorum to replace the paralyzed evertors of the foot. The transplanted tendon functions with sufficient strength to maintain normal muscle balance.

The wound is closed by interrupted sutures with sufficient tension to draw the tuberosity of the os calcis upward toward the knee. In putting on the plaster it is advisable to fix the heel in this position and after this first part of the plaster has hardened, to apply a second portion in which the forefoot is forced dorsalward so as to correct the cavus deformity.

4. *Paralysis of the extensors of the knee.* To correct this condition transplantation of the hamstring muscles is done. In this operation the sheath method is not feasible since the tendons at the knee, unlike those at the foot, are not equipped with a sheath. This is due to the fact that with the exception of the quadriceps, the tendons run approximately a straight course and a sheath is a physiological necessity only when the tendons change their direction. In the case of the quadriceps tendon the knee-joint and the quadriceps bursa take the place of the sheath. The technique of the operation, therefore, is quite different from that employed in the operations about the foot. At the same time, it varies sufficiently from the older operative methods, in certain important details, to justify its inclusion in this sytem of tendon transplantations.

The site of implantation is first prepared by a longitudinal incision extending from a point 2 inches above the patella vertically downward to its lower pole. A small vertical incision is made from the upper border of the

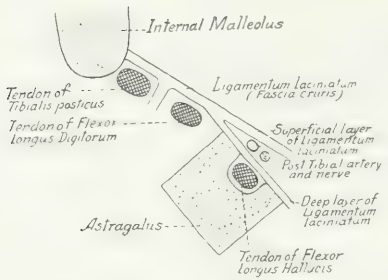
Internal Malleolus
Tendon of Tibialis posticus
Ligamentum lacinatum (Fascia Cruris)
Tendon of Flexor Longus Digitorum
Superficial layer of Ligamentum lacinatum
Post Tibial artery and nerve
Deep layer of Ligamentum lacinatum
Astragalus
Tendon of Flexor longus Hallucis

Fig. 14. Diagram illustrating the fascial planes covering the tendon of the flexor longus hallucis at the ankle. To expose the tendon the superficial layer of the deep fascia (ligamentum lacinatum) must be incised, the posterior tibial artery and nerve drawn toward the ankle and then the deep layer of the fascia opened before the tendon is exposed to view. (From Mayer, *Orthopedic Treatment of Gunshot Injuries.*)

patella to about its middle and a corresponding horizontal incision along the superior border. Two little flaps are thus outlined which are retracted together with the superficial bone layers thus exposing the raw surface of the patella against which the implanted tendons are to be brought (Fig. 16). The second step of the operation consists in reefing the paralyzed quadriceps tendon by means of two mattress sutures. The purpose of this procedure is to pull the patella as far upward as possible so that when the transplanted muscles begin to contract, their full force will be exerted at once to extend the calf instead of expending part of their energy in first pulling the patella upward.

The patient is then turned on the side and a long incision is made exposing the biceps tendon from a point almost half way to the hip down to the head of the fibula. Before freeing the tendon, the external popliteal nerve must be found and drawn out of the way. In cutting away the tendon from its insertion, care must be taken not to injure the external lateral ligament of the knee-joint which it will be remembered, also inserts into the head of the fibula. The tendon and muscle must be freed until its course, when transposed, will be an oblique one and not transverse. The more vertical the pull of the transplanted muscle, the more effective it will be and the sacrifice of a few muscle fibers is more than outbalanced by the increased mechanical efficiency secured by the proper line of traction. The tendon is drawn forward through a subcutaneous channel previously made by means of a stout dressing forceps. The channel must be sufficiently wide to allow free passage and the muscle itself must not be twisted during the transfer.

The biceps is not anchored to the patella at once but before this is done, the patient is again turned so as to expose the inner side of the thigh and through a third incision, the inner group of hamstring muscles is exposed. Any one of these, except the semimembranosus, is suitable.

The operator selects whichever muscle seems most suitable, frees it a sufficient distance upward to make its course straight and brings it forward through a subcutaneous channel similar to that already made for the biceps. The two transposed tendons are then cut off equal in length. Each is threaded with the usual fixation suture and then anchored securely to the patella in such a way as to rest against the raw bone-area already prepared for it. The retracted periosteal flaps are united over the tendons thus pressing them firmly against the bone (Fig. 17). Several stitches are taken above the implantation site holding the two tendons together. This renders the resultant pull almost a vertical one and thus approximates the action of the paralyzed muscle. The operation is concluded by the usual continuous skin sutures.

5. *Inoperable musculospiral paralysis.* Transplantation of flexor carpi radialis, flexor carpi ulnaris and sometimes of the pronator radii teres to the dorsum of the hand for drop wrist. The operation is a complicated one and cannot be considered as reliable as those already outlined, owing to the fact that some of the transplanted tendons have to be attached to the paralyzed tendons instead of directly to the bone. The details of the operation vary somewhat depending upon whether or not the pronator radii teres is used. I shall first describe the operation when the pronator is not employed.

The insertions of the extensor carpi radialis longior and brevior are first exposed by means

Fig. 15a.

Fig. 15b.

Fig. 15, *a* and *b*. These photographs illustrate the effect of transferring the peroneus longus and flexor longus hallucis to replace the paralyzed gastrocnemius and soleus. Before the operation there was a marked degree of cavus and total inability to hold the body weight on the toes. Note the normal form of the foot and the ability of the patient to stand on tip-toe.

of a 2 inch curving incision on the dorsum of the hand. One of the tendons is slit longitudinally and the bone grooved for the reception of the tendon to be transplanted. A second small incision is made just above the annular ligament and a probe passed upward through the sheath of the extensor carpi radialis is made to emerge at this point. If the sheath is found sufficiently roomy to permit the passage of the tendon to be transplanted, a guide suture is drawn through it. If, however, the room is scanty, one of the extensor tendons is withdrawn from the sheath after cutting it off about 1 inch from its insertion. The second incision about 6 inches long on the anterior surface of the arm exposes the flexor carpi radialis tendon. The incision must pass far enough downward to allow the division of the tendon where it is passing through the bony canal of the trapezium, since this is the requisite length of tendon to reach the new site of implantation. The tendon is drawn subcutaneously to the upper pole of the extensor carpi radialis sheath, downward through the sheath, and fastened to the metacarpal bones by the usual fixation method.

Through the small incision at the upper part of the extensor carpi radialis sheath, the long extensor tendon of the thumb is next exposed. Through a third incision over the ulnar aspect of the arm, the flexor carpi ulnaris is found, freed, and drawn to the dorsum of the hand where it is united to the long extensor of the thumb. The suture may be either by means of the Bunnell method or, owing to the fact that the tendons overlap, the thumb tendon may be drawn through a slit in the flexor and united to it by means of several interrupted sutures (Fig. 18). When the operation is performed by this method, complete extension of the fingers is not secured, but an excellent

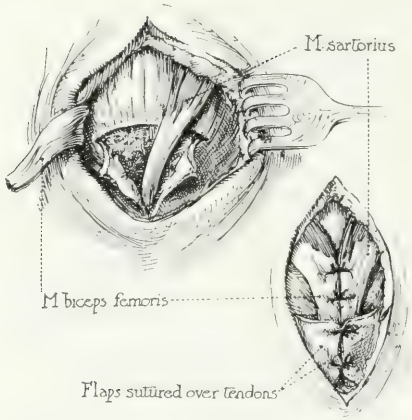


Fig. 16 (at left). This illustrates the method of reflecting the osteoperiosteal flaps from the surface of the patella preparatory to the implantation of the hamstring tendons.

Fig. 17. This illustrates the suture of the osteoperiosteal flaps over the transplanted hamstring tendons after their attachment to the patella. The flaps hold the tendons firmly against the raw bone surface and insure firm union. The tendons are united to one another above the patella so as to make the line of traction as nearly vertical as possible. (From Mayer, *Orthopedic Treatment of Gunshot Injuries.*)

functional result ensues owing to the good dorsal flexion of the wrist and to the fact that the lumbricals and interossei extend the two distal phalangeal joints.

When the pronator radii teres can be transplanted also, a full extension of the fingers can be secured by utilizing the flexor carpi radialis for the extensor communis digitorum tendons. The pronator radii teres is attached directly to the extensor carpi radialis longior and brevior tendons near its point of insertion. The flexor carpi ulnaris is sutured to the long extensor of the thumb as in the preceding operation.

*6. Transference of the flexor sublimis tendon* to replace the divided flexor tendons of an adjacent finger. This operation is indicated when, owing to extensive gunshot injuries, the destruction of the tendons is so great and the scar-tissue formation so dense as to prevent the union of the tendons by the bridging method to be outlined in the next section.

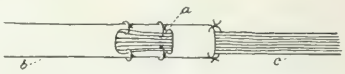


Fig. 18. This diagram illustrates the suture of tendon to tendon when overlapping is possible. Tendon *c* is drawn through a slit in tendon *b* and fastened to it by means of fine chromic gut sutures.

The results, although not perfect, have been satisfactory.

The distal ends of the divided tendons are first exposed by means of a one and one-half inch curving incision. The flexor profundus is identified and threaded with the Bunnell suture. The flexor sublimis tendon of the adjacent finger is next exposed by a 3 inch vertical incision, the tendon cut away at a point sufficiently far distal to allow it to reach to the divided flexor profundus tendon. It is drawn downward beneath the skin to the injured tendon, threaded with the usual suture and united to it with just sufficient tension to render it taut when the finger is straightened out. The divided flexor sublimis is not sutured since I have found that this tends to impede rather than to assist the more important action of the flexor profundus.

*7. Transfer of the extensor communis digitorum tendon* of the index finger to replace the divided extensor tendon of the thumb, middle, ring, or little finger. This operation corresponds to that already described for the flexor tendons. The indication is also given by extensive gunshot injuries in which the free transplantation of tendon is impossible because of dense scars adherent to the bone. The distal end of the divided tendon is first exposed and freed from the surrounding tissues for about one-half inch, then a second incision is made along the extensor tendons of the index finger in their course over the metacarpal bone. The more superficial of the two tendons, namely, that of the extensor communis digitorum is freed from the deeper tendon (extensor indicis). The tendon is cut off at a point sufficiently distant from the wrist to allow it to reach to the distal stump of the divided tendon. It is passed through a subcutaneous channel and fastened to the severed tendon either by the Bunnell stitch or else by overlapping.

Fig. 19*a*. Double photograph (two exposures on one plate) illustrating the range of active motion at the ankle subsequent to the insertion of free tendon transplants to bridge the gap between the divided dorsal flexors of the foot. The tendons function with almost the normal strength and the patient walks without a limp. Operation February, 1920; photographed November, 1920.

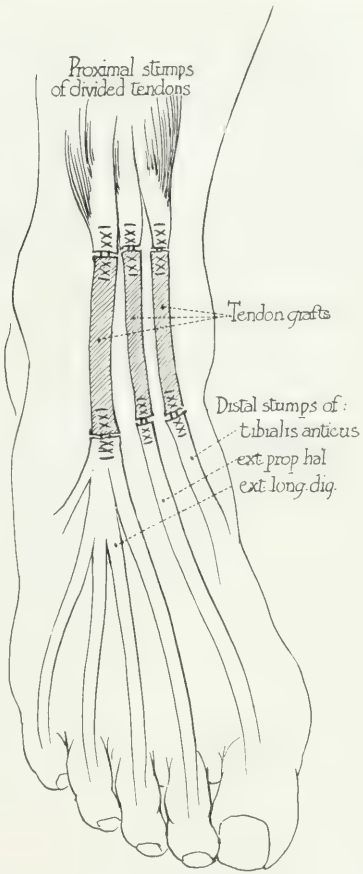


Fig. 19*b*. Diagram illustrating the implantation of tendon grafts taken from the peroneus longus muscle to bridge the gap between the divided tendons on the dorsum of the foot. Each graft about 3 inches long was sutured to the tendon stumps by means of fine chromic gut. The channel for the reception of the grafts corresponded accurately to the normal situation of the tendon sheaths.

GROUP II.—"FREE" TRANSPLANTS

*Free transplantation of tendon.* (Tendon grafts) Operations of this type are comparatively rare. The usual indication is a marked retraction of the ends of a tendon subsequent to its accidental division. In recent cases of traumatic division of a tendon, it is comparatively easy to secure end-to-end approximation of the stump; several weeks or months after the accident the contraction of the muscle has become so great that it is impossible to coapt the tendon ends, and a bridging operation becomes necessary. For grafting purposes I have used the palmaris longus or a portion of the flexor carpi radialis in operations on the hand; the peroneus longus in foot operations. Bunnell recommends the tendons of the extensor brevis digitorum. No operation in the domain of surgery, not excepting nerve or arterial suture, calls for more delicate manipulation. Bunnell's phrase "atraumatic technique" is particularly applicable to these tendon grafts. Two illustrative cases are as follows:

CASE 1. Jean K., 4 years old, while walking through a hay field was run down by a mowing machine which divided all the dorsal muscles of the right foot just at the level of the ankle. Owing to infection of the compound fracture, operative procedure was contra-indicated until 4 months later. At that time the foot was in marked equinus, there was no power whatever of the dorsal muscles. At the operation the distal tendon ends were first found by means of a curving incision made over the dorsum of the foot. As in operations on divided nerves, the tendons should be identified in healthy tissue and then traced toward the point of their division.

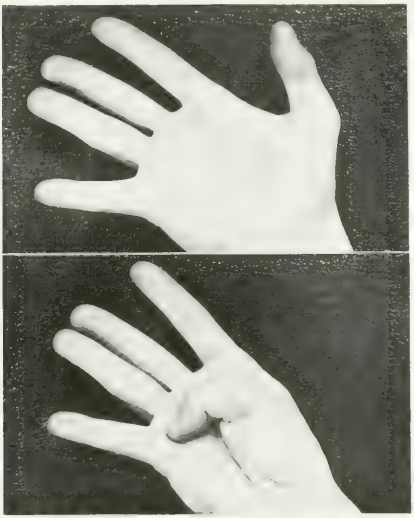

Fig. 20, *a* and *b*. These photographs illustrate the range of active motion of the thumb a year and one-half subsequent to the implantation of a tendon graft bridging the gap between the divided ends of the flexor longus pollicis tendon. Injured October 7, 1918, operated upon December 13, 1918, photographed June, 1920.

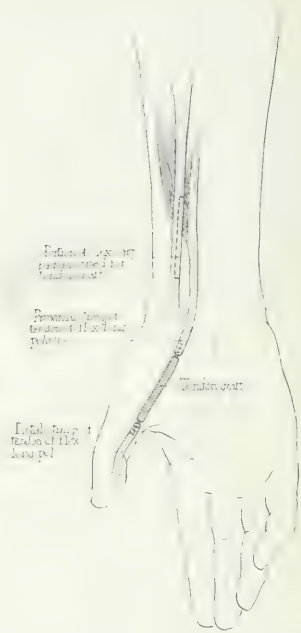

Fig. 20*c*. Diagram illustrating the insertion of the tendon graft in the case illustrated by the preceding figures 20, *a* and *b*).

The corresponding proximal ends were then located through a second incision 2 inches above the ankle. A gap of 3 inches separated the tendon ends. Using the Bunnell tendon clamp, each of the tendons was threaded with No. 1 chromic gut, then the peroneus longus was exposed and from it pieces 3 inches long were excised, threaded with the same type of stitch, and drawn downward through channels previously made connecting the proximal and distal tendon ends. In drilling these channels they were made to follow the course of the tendon sheaths. Each one of the peroneal transplants was united above and below to the corresponding tendon ends (Fig. 19, *b*) and the leg immobilized in dorsiflexion of 90°. The result of the operation is shown in Figure 19, *a*. The sutured tendons 3 months after the operation were functioning with considerable force and at the present time, 9 months after the operation, the child walks without a limp.

Case 2. Mr. H., a druggist's clerk, cut the long flexor tendon of the thumb near the metacarpophalangeal joint. Owing to the death of his wife during the influenza epidemic, he neglected treatment until 2 months later. There were then typical symptoms of complete division of the flexor longus pollicis tendon. At the operation, the distal end of the tendon was first sought through a one inch curving incision just distal to the scar. The proximal end could not be found until a second incision was made running from the annular ligament downward one and one-half inches. The two tendon ends were separated by a gap of two and one-half inches. Using the Bunnell clamp each end was threaded with Pagenstecher linen. Since the palmaris longus tendon was not present, a portion of the flexor carpi radialis tendon was split off longitudinally to use as a graft. By following the natural cleavage lines of the tendon, a rounded, comparatively smooth bridge of tendon was secured. At each end this was threaded with a Pagenstecher linen stitch and drawn downward through the sheath of the flexor longus pollicis which was found to be patent almost its entire length. The transplanted tendon was firmly united to the divided tendon at each end (Fig. 20, *c*), and the thumb immobilized in a semiflexed position. Although the subsequent healing was marred by the discharge of one of the Pagenstecher sutures, firm union of the tendon occurred and complete restoration of function (Figs. 20 *a* and *b*).

GROUP III.—TENDOLYSIS

*Tendolysis for adhesions.* This operation is indicated in cases in which the continuity of the tendons has been preserved but in which motion is prevented by adhesions. A typical instance is the following:

Mr. B. injured the tendons of the little finger some 2 years before I saw him, and as a result was unable to move the little finger except at the metacarpophalangeal joint. Here a dense transverse scar was found which so far as could be determined bound down the tendons to the bone. At the operation, a 3 inch incision was made along the ulnar side of the little finger and the skin flap was retracted until the tendons were exposed above and below the scarred area. On opening the distal portion of the tendon sheath, the tendons were found to be free from the middle phalanx distalward but densely adherent both to one another and to the bone over the entire proximal phalanx. Proximal to the metacarpophalangeal joint, the tendons were free. As the operation was conducted under local anæsthesia it was simple to test the patient's ability to move the tendons, by asking him to flex the finger. This was quite impossible until the tendons had been dissected away from the bone. He was then able to bend the finger about 75 per cent of the normal. The tendons where they had been adherent, had lost their typical appearance and resembled thin bands of scarred fascia. They were about one-third the normal size. To increase their strength as well as to ensheath them with a smooth layer of gliding cells, a strip of fascia taken from the arm, long enough to cover the scarred area of tendon, and of sufficient width completely to encircle the tendons, was wrapped around them and held in place by means of a running stitch which fastened it securely to the injured tendons. The smooth gliding surface of the fascia was turned outward to form a layer corresponding to the gliding cells of the normal tendon. The result indicated in Figure 21 shows about 75 per cent of the normal motion of the finger.

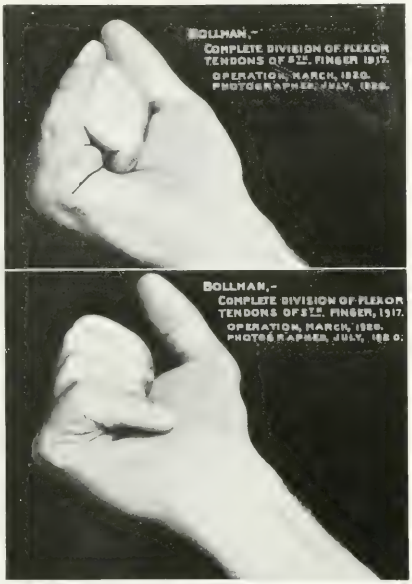


Fig. 21, *a* and *b*. These two photographs illustrate the range of motion of the fifth finger 4 months subsequent to tendolysis. The tendons of the fifth finger were freed from the bone to which they were adherent and surrounded by a fascial transplant whose gliding surface was turned outward to prevent the formation of adhesions subsequent to the operation.

AFTER-TREATMENT

In previous publications I have tried to emphasize the importance of the after-care in cases of tendon transplantation. Even the best operation will prove a failure unless the transplanted tendons are properly exercised, and I have made it a practice to operate only when the entire treatment can be carried out under my direction. The period of immobilization should not, in a case of transplantation on the foot, exceed 3 weeks; for operation on the fingers, not more than 2 weeks. During the immobilization period the limb should be splinted in such a way as to relax all tension on the structures operated on. After the expiration of this preliminary immobilization, active motion of the muscles involved should be begun. Passive motion and massage is of comparatively little significance. It is, therefore, unwise to operate on children who are so young as to be unable to co-operate. In teaching a patient to use a tendon which has been operated on, a little ingenuity is required to bring out the desired result. Thus, after the transfer of the peroneus longus for paralysis of the tibialis anticus, the tendency of the patient is to utilize the extensor longus digitorum instead of the transplanted muscle. The masseuse must teach the patient to relax the common extensor of the toes which is best done by asking him to lift the big toe, while the other toes are held flexed. In this way the

inner border of the foot is raised without the everting action caused by the extensor longus digitorum. Children learn the trick very soon, when they are instructed correctly.

After transferring the biceps to replace a paralyzed quadriceps, the best preliminary motion is to ask the patient to pull the patella toward the hip. After this can be done, the patient is held in an upright position and the attempt is made to lift the leg forward with the knee extended. Within a very few weeks the patient will learn to use the transplanted hamstring muscles as extensors of the knee.

In working with the fingers, the problem is particularly hard since adhesions tend to develop very rapidly. The immobilization period must therefore be made shorter and consequently the healing process is not as complete. In addition to the suitable active exercises the use of little celluloid splints holding the finger at varying angles is helpful in overcoming the natural stiffness. Hot water baths are also of some value, but the essential factor is the active co-operation of the patient in breaking down the adhesions, which, despite every refinement of technique, are almost certain to develop.

When the transplanted tendons have been taught to function, they still require the surgeon's attention, since their strength is almost never equivalent to that of the structures they are replacing. They must be guarded against undue strain by a suitable splint and further strengthened by systematic exercises.

### Prognosis

The prognosis in tendon operations depends almost altogether upon the type of operation. Certain operations should give almost 100 per cent good results, others, not more than 50 per cent. To those giving a high percentage belong the tendon transplants on the foot in which either the peroneus longus or the tibialis anticus is shifted from one side to the other. During the last 3 years I know of only four cases in which these operations have not been successful. In all four instances, a definite cause for failure was ascertainable; in two (transfer of peroneus longus to replace a paralyzed tibialis anticus) the period of immobilization was unduly prolonged because the parents failed to bring the children to the clinic on the appointed day; in two, the transplanted muscle (in one instance the tibialis anticus, in the other, peroneus longus), was too weak owing to its own partial paralysis to do the work expected of it. This percentage of good results does not imply a perfect gliding of the transplanted tendon nor a perfect restitution of the function of the foot; it does mean that the transplanted tendon has sufficient voluntary motion to approximate the action of the paralyzed tendon, and that, though the normal strength of the foot is not regained, the muscle balance is restored (Figs. 6, 7, 8, 9, 12, and 13).

In the third tendon transfer described for the foot (peroneus longus and flexor longus hallucis to replace the paralyzed gastrocnemius and soleus), a normal gliding of the tendons may be expected in all instances. The grave objection to the operation is that the strength of the paralyzed muscles is normally so much greater than that of the two replacing muscles, as to render a complete restoration of muscle balance impossible. The patient is, however, enabled to rise on the toes (Fig. 15) and to walk with a scarcely perceptible limp; running and leaping is impossible.

The operation at the knee is not as perfect technically as the foot operations, but the functional results have been quite satisfactory. In all cases the patient was able to extend the paralyzed leg when standing and in some instances even when lying down. In all cases the gait was much improved.

The tendon transfers on the hand are still less certain procedures, since, instead of attaching the transplanted tendon to the bone, it must be fastened to another tendon. Though this type of union is never as firm as the bony, the period of immobilization may not be prolonged since otherwise adhesions would develop. Despite this inherent difficulty, about 75 per cent good results may be expected.

Of the free tendon grafts I have not done a sufficient number to warrant percentage figures. In the single instance in which grafts were implanted for defects in the tendons on the dorsum of the foot, the result was excellent (Fig. 19, *a*) and in two finger cases, equally good. In two other finger cases, however,

the motion of the implanted tendon was unsatisfactory. These two failures were probably due to the dense scar tissue through which the tendon had to pass. A preparatory operation (Bunnell) in which a fat pad is inserted to replace the scar will probably raise the proportion of successes in cases of this type.

Tendolysis may be expected to restore 50 to 75 per cent of the normal motion of the finger. In these cases as well as in all finger operations, a great part of the success depends upon the co-operation and zeal of the patient, since it is only through the voluntary contraction of the affected muscle that the tendon can be made to glide. No form of passive motion or massage is of any avail. Electrical stimulation may help, but it never gives as great a range of motion as that produced by the voluntary effort of the patient.

## SUMMARY

In the development of the physiological method of tendon transplantation, lies an unusual opportunity for the application of a rational surgical technique to paralytic and traumatic conditions. The essential principle of the method is the correlation of each step of the operation with the known facts of tendon anatomy and physiology, in particular the retention of the normal gliding mechanism of the tendon. Applied to the residual paralyses of poliomyelitis and of gunshot injuries as well as to traumatic injuries, the method has yielded consistently good results. It must be emphasized, however, that the operations are technically difficult, that they require intimate knowledge of the finer details of tendon anatomy and considerable practice on the cadaver. Furthermore, that in the postoperative care as well as in the proper selection of cases, attention to detail is as important as in the execution of the operation.

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# CYSTS OF THE MESENTERY

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SOME months ago, the following case came under my observation, and the comparative rarity of the condition, taken with the difficulty in making a differential diagnosis in this particular case, would seem to warrant a report, together with a short discussion of the general subject of mesenteric cysts.

E. C., an Indian school girl of 11 years, was brought into the hospital suffering with acute abdominal pain. She had been taken ill the previous night with sudden intense pain, profuse vomiting, and gradually rising temperature. The pain, at first generalized, had gradually become localized in the right iliac fossa, later again becoming generalized as the abdominal distention progressed. Immediately previous to the attack, her health had been apparently good, and she had been attending school daily. About the age of 7, however, she had an attack resembling the present one, although not so severe, at which time she was sick 3 or 4 days. Otherwise her previous history was negative.

Physical examination revealed a well-developed and well-nourished girl, who appeared to be in great pain. The tongue was coated. The heart and lungs were negative. The abdomen was moderately distended, with marked muscular rigidity. It was so intensely tender that the slightest touch caused her to cry out with pain. To the right of the umbilicus, and extending below it and upward toward the liver, along the rectus border, was a pronounced bulging, apparently fixed, and dull on percussion.

The temperature by mouth was 101.6°, the pulse 136, and the respiration 36. The leucocyte count showed 21,000 white cells, with 90 per cent polymorphonuclears. The urine was clear, acid, specific gravity 1,022, and contained neither albumin nor sugar.

There seemed to be no doubt but that I had to deal with an appendiceal abscess, and preparations were made for an immediate operation.

Under ether anæsthesia, a right rectus incision was made. Upon opening the peritoneum, the omentum was found to be much inflamed and adherent to a mass about 8 centimeters in diameter, lying to the right of the spinal column, and adherent to the posterior wall of the abdomen. After walling off with packs, the tumor was gently freed by finger dissection, following the lines of cleavage, and finally delivered, when it was found to be a cyst, lying in the mesentery of the ileum, immediately adjacent to the ileocæcal junction, and so close to the colon as to appear at first sight to be a part of it. The colon immediately adjacent was much inflamed. The appendix was free, and while it shared in the general inflammatory reaction of the tissues in the neighborhood, there was no true appendicitis, as the term is ordinarily understood. The omentum was everywhere much inflamed, and adherent to the cyst. After freeing all adhesions, the cyst was shelled out and removed. It lay between the two layers of the mesentery, which was much thickened. The space left by its removal was obliterated by catgut sutures, the appendix was removed, and the abdomen closed without drainage. Recovery was uneventful, and the patient left the hospital on the tenth day, and has since remained well.

An examination of the specimen showed a cyst 8 centimeters in diameter, containing a clear straw-colored fluid. Upon opening it, it was seen to consist of two equal-sized loculi, connected by a minute opening. The inner lining was smooth, resembling a serous membrane. It is to be regretted that no microscopical examination of the cyst wall was made, neither was any analysis made of the fluid.

Mesenteric cysts are rare, or at least have been so considered; in the past few years, however, reports of cases have been appearing more frequently in the literature. They are found most often in the mesentery of the small intestine, and usually near the ileocæcal valve, although they may occur in any part. Rokitansky is usually regarded as the first to call attention to the condition, in the year 1842. Since that time, there have been between two and three hundred cases reported, including all varieties.

There are no signs or symptoms which are pathognomonic of mesenteric cysts. According to Porter, pain is more frequent with this condition than with any other type of abdominal cystic tumor. A history of repeated attacks of abdominal pain, associated frequently with vomiting, and often with alternating periods of diarrhœa and constipation, is highly significant. These attacks are presumably due to increased peristalsis, in an effort to overcome the narrowing of the bowel produced by the encroachment of the cyst upon its lumen; they may also be due to attacks of partial volvulus. This narrowing may occasionally be so great as to cause absolute obstruction; a volvulus may also become

complete. Strangulation and gangrene of the gut due to pressure have occurred.

The tumor, especially if situated in the mesentery of the small bowel, and if it has not become the seat of an inflammatory process, with the production of adhesions, is characterized by its extreme mobility, both laterally and, also to a lesser extent, longitudinally. Of course, this would not apply to a tumor completely filling the abdominal cavity. It is frequently surrounded by an area of gas-filled bowel, which gives a resonant note on percussion; occasionally a distended loop of bowel may cross the anterior aspect of the cyst, giving rise to a band of resonance surrounded by a dull area.

The X-ray may be of great value in certain cases, by showing the relationship of the tumor to the lumen of the bowel, and the amount of narrowing from pressure.

That the diagnosis of mesenteric cysts is difficult, is proved by the fact that no case has been recognized with certainty previous to operation or autopsy. Small cysts may give rise to no symptoms whatever, unless, for some cause or other, an acute inflammatory condition arises, as in my own case. Under these circumstances, acute appendicitis, volvulus, intussusception, rupture of a peptic ulcer, cholecystitis, rupture of an extra-uterine pregnancy in the female, in fact, any or all of the acute abdominal conditions must be considered, and any of these conditions may be so closely simulated that an exact diagnosis will be impossible. As the cyst becomes larger, forming a definite tumor, ovarian cysts, retroperitoneal growths, enormous hydronephrosis, movable kidney, pancreatic cysts, new-growths of the intestine, the pregnant uterus, ascites due to tuberculous peritonitis or cirrhosis of the liver, are all to be thought of. Some of these can be easily ruled out, if ordinary care and intelligence be used in the examination; with others, differentiation is more difficult. However, especially with cysts of moderate size, *having the condition in mind*, the diagnosis should be made more frequently, if due attention be given to the history, the physical examination, and the interpretation of good X-ray plates. In extremely large cysts, differential diagnosis may be impossible; the same holds true for extremely small ones.

Opinion is not in accord with regard to the origin of these cysts, owing to the fact that few have been observed in a sufficiently early stage of their development; consequently, students of the condition have had to confine themselves mainly to theory. Some authorities, among whom may be mentioned Moynihan and Porter, believe that they may have a multiple origin.

According to this view, Moynihan classifies them as follows:

1. Serous cysts, unilocular or multilocular, containing clear serous fluid, and of which the present case is a type; these are supposed to arise from dilatation of lymph channels, or from hæmorrhages between the layers of the mesentery.
2. Chylous cysts, unilocular or multilocular, containing a milky fluid, supposed to arise from obstruction to some of the lacteals, although so far it has been impossible to produce them experimentally. This variety is probably the most numerous, comprising about one-half of all the reported cases.
3. Hydatid cysts, due to the tænia echinococcus.
4. Blood cysts, probably arising from hæmorrhage into preformed cysts.
5. Dermoid cysts, which are undoubtedly embryonic in origin.
6. Cystic malignant disease, possibly also embryonic in the last analysis.

Dowd believes that the majority of these cysts have an embryonic origin, and he classifies them as:

1. Embryonic;
2. Hydatid;
3. Cystic malignant disease.

By Niosi, the embryonic cysts are still further divided thus:

1. Cysts of intestinal origin—
   a. By sequestration from the bowel during development,
   b. From Meckel's diverticulum;
2. Dermoids;
3. Cysts arising from retroperitoneal organs (germinal epithelium, ovary, wolffian body, muellerian duct).

In this connection, a case studied and reported in great detail by Miller is of great interest. It was that of a four-day-old baby, in which the wall of the cyst was in part directly continuous with that of the jejunum, and the histological structure of which closely resembled that of the bowel. In this case, at least, the enterogenous origin by a process of sequestration during embryonic life seems to be established.

It has also been suggested that some of these cysts may represent an unusual form of tuberculosis of the mesenteric lymph glands.

It is very evident from these various classifications, that our knowledge of the etiology of the condition is far from exact. This is due, in large measure, to the condition found at operation or autopsy. The tumors may vary in size from that of a walnut to enormous cysts filling the abdominal cavity; they may be unilocular or multilocular, and the wall is usually composed of a fibrous membrane of varying thickness, from which all trace of the original histological structure is lost, due to the pressure of the contained fluid. This fluid may be of any character; in addition, it is self-evident that the character may change by reason of hæmorrhage or entrance of infection into the cyst; thus, a serous cyst might readily, and undoubtedly frequently does, become converted into a blood cyst. For this reason, any classification based entirely upon the cyst contents is extremely likely to be misleading, especially when used as a basis for statistics of frequency of occurrence of the various forms.

Moreover, the term "mesenteric cyst" has, in my opinion, been heretofore used to cover too broad a field; a point of view which has also been held and ably discussed by Child, Strong, and Schwartz. For example, a malignant tumor with cystic degeneration occurring in the mesentery, while undoubtedly a "mesenteric cyst," when its location alone is taken as a basis for classification, nevertheless still belongs to the class of malignant tumors. Therefore, it should be classed with these tumors, regardless of its location. The same holds true for dermoids and parasitic cysts. This brings us to the true mesenteric cysts. There is no doubt but that many, if not most, of these true cysts are embryonal in origin; others may arise from Meckel's diverticulum, or from sequestration from the bowel during development; also, from some of the evidence presented, it seems extremely likely that obstruction to the lymphatics or lacteals may result in cysts in certain cases. As a working classification for the study of cystic tumors of the mesentery, I would suggest the following:

1. True mesenteric cysts, subdivided, according to their probable origin, into—
   a. Embryocystomata,
   b. Enterocystomata, by which I understand not only tumors of Meckel's diverticulum, but also tumors arising from sequestration from the bowel,
   c. Obstructive, possibly;
2. Dermoids;
3. Cystic malignant disease;
4. Parasitic.

By applying this classification to all cystic tumors of the mesentery, more uniformity of description would at least be obtained than at present exists in the literature.

### TREATMENT

There are five possible methods of dealing with cases of mesenteric cysts: (1) aspiration; (2) marsupialization; (3) incision and drainage; (4) enucleation; (5) if the bowel is affected, resection of the affected portion, with excision of the cyst.

Of these five methods, enucleation, if possible, or excision together with a segment of bowel is the operation of choice. Aspiration has no place in modern surgery, although it was the favorite procedure with the older surgeons. Marsupialization is also obsolete, and properly so, unless in very exceptional instances. Incision and drainage may occasionally have to be resorted to in an acute phase of the disease, when more extended operative procedures would greatly jeopardize the life of the patient, or in the case of an extremely large cyst, or one surrounded by dense adhesions, when enucleation or resection of the bowel is out of the question. Of course, in those cases which have been drained, recurrence is extremely likely. The ideal procedure is enucleation, and in the average case, when the cyst is not too large, this can

be readily accomplished. If the blood supply of the adjacent bowel is markedly interfered with, however, the affected loop must also be resected.

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# ACTINOMYCOSIS OF THE CÆCUM[1]

By F. WEBB GRIFFITH, M.D., F.A.C.S., Asheville, North Carolina

MERELY because in the past year I happened to have had two cases of actinomycosis, or at least one definite and one probable case, would not be sufficient justification for reporting them were it not for the fact that in a surgical experience of 15 years I had not previously seen, or at least had not recognized, a single case. Inquiry among several of my colleagues revealed the fact that they were as ignorant about the subject of actinomycosis as I was. For that reason I am presenting this paper, hoping that we may have a discussion which will help to enlighten all of us.

In 1845, von Langenbeck first discovered the organism to which Harz later gave the name of actinomycosis or ray-fungus.

Bollinger first discovered the disease in the ox and gave it the name of "lumpy-jaw," or big jaw. To Israel is given the credit of discovering the first case in man.

For many years it was uncertain as to how the infecting organism should be classified and some of the types have been erroneously included among the higher bacteria. The yellowish, so-called sulphur granules, about 2 millimeters in diameter, can be readily seen with the naked eye. Microscopic examination shows these granules to be composed of cocci and radiating threads which take the Gram stain.

Schlegel showed that the dried spores germinated after 238 hours of exposure to sunlight. Odermatt described 8 cases of actinomycosis of the mouth apparently contracted from sleeping on straw or hay. In one of the cases he felt convinced that the incubation period had been 8 months.

In the majority of cases the mouth, and especially a carious tooth, seems to be the portal of entry, although involvement of the skin of the neck and head is almost as frequent as of the jaw.

The symptoms are usually those of an extensive ulceration. The process may be progressive and destructive in one area, while an adjacent region is healing by the formation of fibrous tissue.

Apparently actinomycosis does not spread by the blood or lymph, but rather by continuity and contiguity.

Letulle and Hufnagel described a case starting in the œsophagus and spreading directly through to the heart and also to the right pleura and to the base of the right lung. Apparently no structure has the power to resist its invasion.

In the second case I shall report, the lesion apparently started in the jaw, and the cæcum became involved by the organism being swallowed. From the cæcum the infection obviously burrowed through into the loin.

Osler says: "As in tubercle, the first effect is the destruction of adjacent cells and the attraction of leucocytes—later the surrounding cells begin to proliferate. After the tumor reaches a certain size there is great proliferation of the surrounding connective

[1]Read before the North Carolina Section of the American College of Surgeons at Charlotte, North Carolina, January 28, 1921.

tissue and the growth may, particularly in the jaw, look like, and was long mistaken for, osteosarcoma. Finally suppuration occurs, which in man, according to Israel, may be produced directly by the streptothrix itself."

Illich, analyzing 421 cases in man, found the following distributions: skin, 2.67 per cent; lungs, 13.8 per cent; abdominal, 21 per cent; neck, 51.8 per cent. The location of the remaining 11.8 per cent was not stated.

The diseases from which actinomycosis usually has to be differentiated are tuberculosis, cancer, and syphilis.

Pulmonary actinomycosis is evidently very rare as several of the lung specialists of Asheville who have examined thousands of cases with pulmonary diseases tell me that they have not seen, or at least have not recognized, a single case.

Illich found no recoveries in 58 cases of actinomycosis of the lungs, while Mayer found 7 recoveries in 35 cases.

Gourgerot reports 2 cases of cancer wrongly diagnosed actinomycosis. The diagnosis was made from the presence of yellowish granules similating the ray-fungus and in which the filaments took the stain. It was only by microscopic examination of the excised tissue that the correct diagnosis was made.

The Wassermann test would probably differentiate syphilis from actinomycosis.

Report of my cases follow.

Case 1. Mr. M. M., white, age 31; railway fireman; denies venereal diseases; was admitted to the hospital March 4, 1919. For 4 or 5 months he had had at intervals severe cramps. The attacks at first were more or less vague, extending over entire abdomen, but later localizing in right side. The cramps would last half an hour and until a short time before admission did not necessitate going to bed. There was nausea, but no vomiting. Patient had suffered for many years with constipation. On admission to hospital the heart and lungs were normal, abdomen was normal except for slight tenderness in McBurney region and slight rigidity over right rectus. Urine was normal. On March 5, 1919, through a right rectus incision a chronically inflamed appendix was removed, but was not subjected to microscopic examination. The other abdominal organs were normal. Patient left hospital in 14 days and remained perfectly well for 6 months. At the end of that time he began to have some vague pains in right side of abdomen similar to the pains before operation, only much worse. Attacks became more frequent, often lasting for an hour, with nausea and vomiting. The pain became worse and frequently necessitating remaining in bed 1 to 2 days. The vomiting seemed to bear no relation to the pain and would frequently come 5 or 6 hours after meals. His diet was finally reduced to nothing but thin liquids. I saw him April 1, 1920, for the first time since leaving the hospital a year previous. At this examination patient had obviously lost considerable weight and in the region of the cæcum could be felt a sausage-shaped mass the size of a small banana, and fairly freely movable. Operation the following day showed the tumor in the cæcum. It was fairly hard and one was struck by the large amount of fibrous tissue. There was slight enlargement of the mesenteric glands. There was no tendency to ulceration or breaking down of the tumor. The terminal ileum together with the cæcum and about two-thirds of the ascending colon was removed. The ileum was then anastomosed to the transverse colon. Patient made excellent recovery and since then has been working full time and eating whatever he wants.

X-ray taken recently, 9 months after operation, shows that the anastomosis is functioning well. There is also nothing to indicate a return of the trouble. The tumor was removed under the mistaken diagnosis of malignancy, but the report from Professor Winternitz, professor of pathology at Yale, states that it was probably actinomycosis. I wrote later asking if he was positive of the diagnosis, also how many similar cases he had seen in his large experience and received the following reply:

"I had sections stained by the acid fast and Gram methods, but I am sorry to say that I have been unable definitely to determine the etiological factor of the condition. I still feel that the inflammatory process represented in the intestinal wall is a fungus variety and although an occasional strand or thread, or even a rosette-like function is found, these are not clear enough to be positive diagnostically. I will have more sections made and if new findings present themselves I will let you know."

He also stated that he had seen only two other similar cases, one a specimen sent to him a year ago and the other an autopsy case at Hopkins several years ago showing primary intestinal actinomycosis with subsequent invasion of the liver and abdominal wall.

Case 2. Mrs. S. H., white, age 38, married. Family history is negative. Patient has had usual diseases of childhood, otherwise perfectly well. She has been married 22 years and has had 9 children and no miscarriages. Since 1909 patient has been living on farm and doing the usual duties of a farmer's wife. About 9 years ago her husband bought a cow, which had "lump-jaw." The cow was sent away in 3 or 4 days. He has had no other cases among the stock.

In the early spring of 1920 patient had abscess of right lower jaw. In about a week the abscess broke

giving her complete relief, but it has reformed several times since. In May, 1920, patient had a severe attack of colic, lasting 2 or 3 days, but she did not go to bed. Had vague pains in abdomen and some indigestion following that attack, but no violent pain until August 28. About midnight of that date she was awakened with acute pain in abdomen, which she described as very much like labor pains. Pain was severe enough to require an opiate and she was kept under the influence more or less until her admission in the hospital 5 days later.

Physical examination on admission to the hospital September 21, 1920. Patient was obviously desperately ill. The heart, lungs, and urine were negative, the abdomen was quite rigid, especially over the right side and across the lower part. The red count was 4,448,000, hæmoglobin 50 per cent, leucocyte count 27,500, Wassermann negative. Pelvic examination showed the uterus anteflexed. A feeling of rigidity and induration in the right fornix. The left fornix was slightly tender. Midline incision showed there was an abscess behind the uterus containing about 3 ounces of pus. The pelvic organs were firmly massed in adhesions. The appendix and cæcum were also bound down in the mass of firm pelvic adhesions. The uterus together with both tubes and ovaries was removed by supravaginal amputation. Three drains were placed through into the vagina. The raw areas were covered over with peritoneum and the cervix suspended by the round ligaments. The necrotic appendix was removed and the cæcum was found to be markedly thickened and friable. The infection apparently started in the cæcum. Patient made excellent recovery and left hospital in 18 days.

On November 14, 7 weeks after she was discharged from the hospital, she was re-admitted with an abscess the size of an orange in the right loin. Her temperature was 105° and pulse 120. The abscess was drained and about 6 ounces of pus escaped. The cavity apparently extended directly forward to the region of the cæcum. At this operation we first recognized the typical yellowish sulphur granules, which microscopically proved to be actinomyces. A few days after this second operation patient developed another abscess of the lower jaw from which the ray-fungus was obtained. The jaw was thoroughly curetted by a dentist and patient was put on potassium iodide, grains 60, three times a day for 4 days. After 2 weeks rest same dosage was repeated. She was given X-ray treatments over the right loin. X-ray showed the lungs were clear. Patient has improved enough to leave the hospital, but is still a long way from being well.

# SOME OBSERVATIONS ON CASES OF NONUNION OF FRACTURES IN THE LOWER THIRD OF THE TIBIA

By E. L. ELIASON, A.B., M.D., F.A.C.S., Philadelphia

IT is a well known fact that a great percentage of fractures of the lower third of the tibia result in delay or non-union. It is further generally recognized that fractures elsewhere in the tibia almost invariably result in firm union under similar conditions and circumstances. When one endeavors to determine the cause, attention must be directed to two groups of factors: the extrinsic and the intrinsic.

Under extrinsic factors must be considered treatment as typified by fixation and position. These can be dismissed as having no bearing on the result, as we all know that in some cases of simple fracture with little swelling and slight evidence of trauma, despite good reduction and perfect fixation in good healthy young adults, we get delayed or non-union.

Under intrinsic factors we have as the chief conditions the reduction of the fracture and the blood supply. The accuracy and the absolute perfection of reduction has little or no bearing on the result in this fracture. I think it is generally conceded that union occurs in almost every shaft fracture of a long bone despite overlapping and angulation, provided no substance foreign to the site (such as interposed muscle, loosened displaced bone fragments, shell fragments, bullets, etc.) lies between the ends. The noticeable exceptions to this are neck of femur and midshaft of humerus. Each of these has a definite well known cause. In the fracture of the neck of the femur it is lack of blood supply. In the shaft of the humerus it is faulty fixation and poor blood supply to the lower fragment. In the fracture under consideration we almost never meet interposition of soft parts and rarely in civil life with extraneous foreign bodies. The factor that does seem to be of significance in its peculiarity to fractures in this neighborhood is the anatomy and its blood supply, and the effect that the primary injury, the injury consequent upon forcible reduction and the subsequent prolonged elevation of the limb, has upon this same blood supply.

*Anatomy.* The soft parts in the lower third of the leg are compactly situated with little areolar tissue between them. The nerves, vessels, and tendons are all enveloped in a sheath of deep fascia that is thick and strong enough almost to be termed an aponeurosis. This fascia permits of almost no stretching; hence any swelling occurring beneath it must of necessity cause pressure upon the contents beneath it. The vessels being the most readily compressible structures are, of course, the first to be affected. Where this fascia remains intact, in fracture cases, the effect of the swelling is noticed in a lessened or softened pulse in the dorsalis pedis artery and a tenseness of the tissues with but little real increase in the total circumference of the limb.

In cases of compound fracture and in those cases where the fascia has been torn, the extravasated blood escapes, the swelling rapidly reduces and the bleb formation, which is an evidence of trophic disturbance, is diminished or even absent. Furthermore in these cases of serious injury, the swelling is widely distributed, is soft, and subsides early, leaving the foot warm and of a natural color.

*Blood supply.* The arterial supply to the leg is derived from the anterior and posterior tibials. The nutrient artery enters the tibia in its upper third and consequently is cut off from the lower fragment in fractures in the lower third of this bone. In some anatomies the posterior tibial artery is described as giving two or three articular branches to the lower end of the tibia; in other anatomies there is no reference to any posterior tibial branches supplying the lower end of the tibia.

The anterior tibial artery in the lower fourth of the leg lies immediately against the tibia with no intervening muscle protection. It gives off at this level several small periosteal branches to the tibia. At a lower level it gives

off the internal and external malleolar branches which supply the greater portion of the ankle-joint. The writer dissected 18 legs with a view to demonstrating the blood supply of the tibia. The conclusions reached were:

The anterior tibial artery is the source of the greater proportion of the blood supply to the lower end of the tibia.

The anterior tibial artery lies in a position which directly exposes it to injury from bone fragments in lower tibia fractures, which can easily result in thrombosis or even a laceration of the arterial wall itself.

The lower third of the anterior tibial artery lies in a well defined rigid gutter between the bones on either side, the interosseous membrane behind, and the dense deep fascia of the lower leg in front.

Although the arterial anastomosis of the ankle and foot is a very rich one, nevertheless, the lower end of the tibia comes in for a very small portion of it. The posterior tibial probably contributes most to this anastomasis, at least, our experience with wounds of these arteries in the last war would warrant such a statement. When a posterior tibial artery was severed it meant, practically always, gangrene and amputation. This was not nearly so often the case in anterior tibial wounds.

With these facts in mind it can be readily understood what serious effects upon the blood supply of the lower fragments may occur if excessive swelling partially obstructs the artery or the broken bones wound the vessel causing a thrombosis or even a laceration. Some one of these conditions frequently comes to pass as is evidenced by the diminished and often barely palpable pulsation in the dorsalis artery.

*Clinical findings.* The blood supply here again claims our attention. In a series of non-union cases of the tibia it was noted that the foot on the affected limb was often cooler than the other. Frequently the dorsalis pedis pulsation was noted to be weaker. In this series of 11 cases of delayed or non-union, some cases operated upon and some not operated upon, blood pressure readings were made. With the patient in bed and both clowr limbs elevated 30 to 35 degrees the blood pressure taken in the injured leg below the site of the injury was invariably found to be lower than that of the other leg. This difference ranged from 5 to 15 millimeters mercury. With the limbs in the hanging position and the patient sitting up the difference was still present but to a less degree, ranging from 5 to 10 millimeters. These all were systolic readings taken by palpation. In two of the cases the pulsation could not be obtained in the dorsalis pedis artery so was taken in the posterior tibial.

*X-ray findings.* When the X-ray plates of these fractures are examined, a marked difference is at once noticed between the upper and the lower fragments. The lower fragment shows a more marked osteoporosis and absorption. It also shows less callus shadow.

*Operative findings.* On exposure of the fracture the X-ray findings are borne out. The lower fragment is softer, spongy, osteoporotic and shows less callus activity. There is very little if any filling in of the medullary canal. The sawn or curetted lower fragment produces less hæmorrhage than the upper. The blood simply oozes out whereas in the upper fragment, the nutrient or medullary artery often has to be crushed against the bone in order to obtain hæmostasis. In cases where plates and screws have been used, the screw holes in the lower fragments show little evidence of being filled in by bone, but on the other are often much larger, from absorption, than are the screw holes in the upper fragment.

In three cases the sawn sections from the two ends of the bones were examined in the laboratory with reference to the degree of bone formation. In all the cases there was less bone formation reported in the lower section.

Reports of microscopical examination from the University of Pennsylvania pathological laboratory are given below:

Case No. 6454. Fragments of tibia. A. Upper fragment. Portions of very dense tissue are seen and in a very dense matrix, composed of fibrous tissue and blood vessels are seen large numbers of cartilage cells, with here and there a small area of beginning calcification. There are some spicules of bone present which probably represent a pre-existing bone and not a new formation. The slide shows

active proliferation of the various elements necessary to bone formation.

B. Lower fragment. This slide contains portions of old cortical bone but the picture is one of disintegration rather than proliferation. There is an attempt to form new bone in one or two areas only.

Case No. 6570. A. Upper fragment. The slide shows cortical bone which is very dense and apparently unchanged in other respects.

B. Lower fragment. This slide shows some areas of tissue resembling cancellous bone. There is no evidence of bone proliferation. Some of the tissue has undergone a degenerative process, the bony structure being recognized with difficulty.

*Experimental findings.* Seeking to prove or disprove the effects of injury to the anterior tibial artery on fractures of the tibia a series of 12 dogs were operated upon. In all 12 the hind leg was fractured in the lower third. In four controls nothing further was done except fixation with plaster-of-Paris dressing reaching from around the body, to and including the foot. It was found necessary to include the foot and toes in order to prevent the dog from walking with the limb. In 8 dogs, in addition to the fracture, the anterior tibial artery was doubly ligated and severed. In 4 of the ligation cases the nerve was also cut. In none was there any especial attempt to get perfect reduction of the fracture. At the end of 4 weeks all the dogs were killed and the bone specimen removed and examined grossly and with the X-ray. In the four controls the union was solid and the callus formation apparently uniform. In the 8 ligation cases there was union, but in 5 of these the union was not as firm as in the controls. The cutting of the nerve seemed to have no effect upon results. The X-ray showed no demonstrable difference in the callus between the controls and the ligated cases.

## CONCLUSIONS

The above evidence points to the fact that there is a lessening of the blood supplied to the lower fragment in these cases, which condition is associated with lessened bone reparative activity. The anatomy of the part leads us to turn our attention to the anterior tibial artery for the explanation. The fact that in the elevated position the blood-pressure difference between the affected and the normal limb is greatest should warn us to lower these fractures at the very earliest moment. Furthermore, the exposed and vulnerable situation of the artery to this the most frequent fracture site of the tibia should be a warning to us to be careful not to inflict traumatism in our reductions.

# KRAUROSIS VULVÆ AND INGUINAL ADENITIS OF A MALIGNANT NATURE[1]

By FRANCIS REDER, M.D., F.A.C.S., St. Louis

THE two cases of kraurosis coming under my observation present the singular interest that in both instances a malignant degeneration was demonstrable. The one case exhibited a malignancy of the left labium with involvement of the left inguinal glands, the other case presented a malignancy in the region of the fossa navicularis encroaching upon both the right and left labium and involving the glands of the right and the left inguinal region.

Both women were married, had passed their menopause without ever having been pregnant and were respectively 51 and 54 years of age. The general health had always been good and only in latter years did the bodily weight take on an appreciable increase.

Itching of the vulva and a leucorrhœa had existed for about 4 years. The itching was of an intermittent character, at times mild and then again almost intolerable. The leucorrhœa also showed periods of variability, these being characterized by an almost complete cessation or a marked profuseness. It was noticed that whenever the leucorrhœal flow was slight the itching and burning about the vulva was much diminished. A severe attack of itching usually presaged a copious discharge. These patients felt more comfortable with a leucorrhœa of moderate severity.

In this condition Mrs. F. drifted along for 2½ years when she was compelled to consult a physician on account of great pain caused by coitus. An ulcer was discovered by her physician which was treated with "most everything" including roentgen-ray therapy. The condition grew worse, the ulcer growing to the size of a 25 cent piece in about 4 months. Excision of the ulcer was then undertaken. Nine months later the patient noticed a lump in her left inguinal region. This mass gave evidence of rapid growth. It was on account of the inguinal condition that my advice was asked.

The second case, Mrs. S. sought medical advice only after severe pain made coitus impossible. An examination disclosed conditions about the vulva which were interpreted by the physician as changes that naturally followed the menopause. This patient was treated locally with lotions and ointment. An examination 4 months later showed a well developed ulcerative area in the region of the posterior commissure. This was cauterized and treated with X-ray radiation. Under this treatment the ulcerative area encroaching upon both the right and the left labium did not appear to enlarge, neither did it show any disposition to heal. About 6 months after the cauterization of the ulcer patient felt a pain in her left groin. Placing her hand upon the site of pain she felt a small tumor. At the same time she made an examination of her right groin and there also discovered a swelling. My advice was sought with reference to the inguinal enlargement.

The clinical picture of these two cases presented the evidence of the Breisky syndrome in its extreme characteristics, with the addition of a typical cancer degeneration.

In both a burning and smarting sensation was present. There was a malodorous discharge from the infiltrated cancerous ulcer. The ulcer was irregular in outline and presented itself as a dirty granulating sore. Its tendency was to spread along the mucous surface toward the vagina, then outward over the skin and the labium. The mucous surface had lost its normal characteristics. It appeared a dead-white, thickened, smooth, and dry. About the surface there were scattered four to six reddish and brownish spots, which when touched were very sensitive.

No glans clitoris nor any labia minora were present, these structures having become obliterated during the progress of the disease.

The ostium vaginæ was abnormally narrow and appeared as though it had become cicatricially stenosed. An attempt to introduce the index finger into the vagina caused bleeding and much pain. Atrophic changes seemed to have taken place in the labia majora, and the mons veneris. A partial alopecia was apparent.

In the case of Mrs. F. a tumor the size of a tangerine occupied the left inguinal region. The case of Mrs. S. presented a tumor the size of a hen's egg in the right and the left inguinal regions. Both women were able to be about and felt fairly well. In the analysis of these two cases it can be demonstrated that the course of the disease ere it terminated into the stage of cancer, a degeneration fortunately not often encountered, passed through three distinct pathological phases: pruritus, leucoplakic vulvitis and kraurosis.

A simple pruritus vulvæ which is usually present in an innocent way for many years, can undoubtedly be responsilbe for subsequent morbid changes involving the mucosa of the external genitals. Trauma to the

[1] Presented at the meeting of the Southern Surgical Association, Hot Springs, Va., December 11 to 13, 1912.

epithelium of the vulva inflicted upon the burning and itching areas for relief is the precipitating factor in producing a low grade infection of the underlying connective tissue. An exudation of plasma occurs, the result of tissue reaction. The continued infection followed by exudation and infiltration causes œdema and this is seen clinically as engorgement, softening, and lividity. Eventually the affected area looses its normal color, becoming pale and dry, assuming the appearance of parchment. The vulnerability of the impaired structures becomes great on the slightest provocation and an added traumatism, such as a fissure, may engender a more severe form of pruritis which might finally develop into a leucoplakic vulvitis.

It is reasonable to assume that not in every instance does a leucoplakic vulvitis follow a pruritus. The pruritic stage may merge into the condition of kraurosis without a leucoplakic lesion. In kraurosis, however, where a cancer degeneration has taken place, the presence of a leucoplakic vulvitis must be accepted, inasmuch as there is no tendency to a malignant degeneration in kraurosis. There is, however, a tendency to a primary cancer of the vulva in leucoplakia.

A leucoplakic vulvitis is a disease which occurs in women past the menopause and is due either to natural atrophy of the glands at the time of the normal menopause or else to their surgical removal.

The histological changes are located in the epidermis and consist primarily of an absorption of elastic tissue from the uppermost layers of the corium over a portion or all of the vulva internal to the hairy portion of the labia majora (Taussig). The absence of elastic tissue invites trauma with a resultant low grade infection of the underlying connective tissue. As the disease progresses the affected areas become covered with thickened epithelial plaques, whitish in color. These plaques may cover more or less fully the entire area diseased.

Kraurosis, the last of the trinity, is a chronic infection the result of repeated traumatism with low grade infection usually occurring in women after the menopause. The fact, however, must not be overlooked that in younger women factors favorable to its production are found in a postoperative menopause. The three lesions have much in common and it can reasonably be assumed that a kraurosis is the final chapter to the damage done to the tissues by the lesions which invariably precede it. The characteristic state in which the vulva has been transformed by these extreme pathological processes has suggested the name kraurosis. It is a word coined from the Greek "κραῖρος," meaning "dry."

In kraurosis the histological changes are situated in the dermis and usually present a general atrophic process involving the entire vulva, with marked contraction of the vaginal orifice.

Not infrequently the glans clitoris and the labia minora have disappeared and the ostium vaginæ has become narrowed to such an extent that an attempt to introduce the index finger, if at all possible, is causative of great pain. Some cases frequently show atrophy of the mons veneris with complete alopecia. A patient afflicted with this disease is often a great sufferer, and not only is coitus very painful, but the itching and burning is frequently unbearable.

The assumption that the pathological process of kraurosis vulvæ can be accepted as an inherent primary disease appears to me to be still strongly lacking in corroborative evidence.

A critical analysis of the clinical picture of pruritis and leucoplakic vulvitis discloses so many features in common with kraurosis that the inference could be made that kraurosis is an expression of a severe degree of these lesions, and that without pruritis and leucoplakic vulvitis there would be no kraurosis.

The term "kraurosis vulvæ" can, therefore, be conveniently accepted as a lesion secondary to the pathological processes excited by pruritus and leucoplakic vulvitis, depicting the clinical picture of the impaired vulvar tissues in their most distressing condition. A kraurosis vulvæ degenerating into malignancy is as rare as a kraurosis lesion itself. This is very fortunate inasmuch as vulvar carcinoma demands an extensive

operative measure, even though the relief afforded be of short duration.

The mortality in cancer of the external genitals is high because of the frequency with which the tributary glands are involved early in the disease.

Just why cancer should be of rare occurrence in a kraurosis vulva is difficult to explain. The necessary factors conducive to malignancy are present, and present for a long time; the irritation and the debilitating influences caused by prolonged suffering are plainly apparent and the law that carcinomata have a predilection for surfaces where a transition takes place from one variety of epithelium to another is fairly well applicable to this condition, yet carcinoma as a sequela to kraurosis is said to be infrequent. Nevertheless a patient afflicted with kraurosis should be safeguarded against any possible malignant changes, and the lesion subjected to a measure radical in its execution. This measure is an operative one and consists in the complete excision of the affected area.

In the earlier stages before the clinical picture becomes pronounced and an intense pruritis apparently is the only existing condition, the source of the irritation should be sought and if possible removed. An intense pruritus not amenable to treatment is a condition which justifies excision of the areas involved. When the lesion presents itself as a pronounced kraurosis and is associated with a leucoplakic vulvitis, an association not at all infrequent, we should appreciate the experience of others who have subjected these conditions to radium and roentgen-ray treatment. The results of these treatments have been most disappointing and in frequent instances have caused much suffering to the patient. In three instances Taussig used radium with only temporary improvement after a period of extremely painful radium reaction. In the hands of the same observer, roentgen-ray and radium treatment in cancer of the vulva have given most unsatisfactory results.

Some investigators recommend in a pronounced condition of kraurosis with dyspareunia an incision widening the vaginal outlet. I would advise against this procedure as it has little to recommend. It has no beneficial influences upon the condition, and does not prevent a subsequent contraction of the ostium.

Reverting to the two cases with infiltrated cancerous ulcers and metastases in the inguinal glands, a radical excision was made in each instance. The operation pertaining to the inguinal dissection requires a technique of much delicacy and is somewhat severe. An operation of this character cannot be a satisfactory one unless all inguinal glands are removed, especially important ones situated deeply around the femoral vessels. Such a dissection requires the division of Poupart's ligament.

The relief these patients obtained was most gratifying. Up to date they are free from any of their former suffering, with no evidence of any recurrence.

The operations were performed respectively 9 and 11 months ago, a time allowance too brief in the consideration of recidivation.

# BILHARZIASIS

By ROBERT V. DAY, M.D., Los Angeles

THE rarity of bilharziasis in the United States prompts me to report the following case:

Mr. C. F. B., age 24, medical student, born and reared until the age of twenty in the Transvaal, British South Africa, has been having slight hæmaturia much of the time for 2 or 3 years. He was seen first June 5, 1920. The symptoms described by him were: (1) occlusion of urethral orifice by unknown cause during urination; (2) hæmaturia.

He had been having hæmaturia for the 3 weeks just preceding and had been unable to void for 24 hours. A catheter had been used obtaining bloody urine with difficulty because of clots obstructing the catheter lumen. A great mass of clots was evacuated with the evacuating pump of Ware. Cystoscopy then disclosed a considerable mass of clots left in the bladder but not enough to interfere with cystoscopy. A typical benign-looking papilloma near the left ureteral orifice was seen and fulgurated thoroughly. Microscopical examination of the urine by Dr. Herschel Butka, pathologist to the White Memorial Hospital, disclosed typical ova of the distoma hæmatobium with characteristic terminal spines. These were present at all examinations of the urine up to and shortly after beginning of specific intravenous treatment of tartar emetic.

On July 7 cystoscopy was done and the base of the papilloma was fulgurated. There were present over the trigone, principally over the left side, and on the bladder neck, small miliary papules reddish white in color. The ureters were catheterized at this time to obtain eggs direct in case left kidney was infected. No eggs were found, however.

Cystoscopy was repeated on August 26. Hundreds of these miliary papules were present in practically every portion of the bladder wall. This alarmed me and the question of intravenous injections of tartar emetic was advised after the question had been taken up with Dr. Stitt of the Tropical School of Medicine. He was treated under the supervision of Dr. Newton Evans, president of the College of Medical Evangelists. I can hardly improve upon the patient's own report which is as follows:

"*General measures in treatment.* 1. Physical exertion reduced to a minimum.

"2. Breakfast is light on mornings of injections.

"3. After injection 2 hours of absolute rest.

"4. Mental work reduced to minimum yet sufficient to 'get by.'

"5. Sleep encouraged by warm bath before retiring and bed time at least 9 hours.

"6. Regularity at meals.

"7. Keep bowels active."

*Note.* In the urine there always had been a certain amount of pus but as the doses increased this decreased until with the reds it vanished.

The color of this urine was always normal but at first rather cloudy. This cloudiness, however, subsided as the albumin and reds decreased.

There always was a slight cystic and urethral irritation showing itself in a sense of tension, but not associated with pain. This had disappeared after having taken 7¼ grs. of tartar emetic. (See Table.)

DISCUSSION

"Certain symptoms were continuous throughout the whole course of treatment: These were, bronchial irritation, pleural pain, backache, mental depression, conjunctivitis, vertigo, and muscular weakness. After each injection they became worse within 30 minutes from time of administration and continued 24 to 26 hours afterward.

"There was a week omitted between November 19 and 27 when the administration was suspended on account of the accumulative poisoning symptoms becoming very marked. The treatment lasted a month and 5 days and the total amount of tartar emetic was 15 grains.

"During the whole time sleep and appetite were fair, except the last two administrations caused a loss of appetite. The bowels moved sluggishly and, therefore, cathartics were frequently resorted to. Every evening a hot spray was taken to promote sleep and restfulness during the night.

"Each day one-half grain of dessicated thyroid (P. & D.) was taken to stimulate metabolism and thereby increase mental activity, thus counteracting the depression of the drug. It was found necessary to take an increased mental stimulant with each final examination, consequently 10 grains of caffeine citrate were taken in divided doses 4 and 2 hours respectively before each of three final examinations that came during the period of administration. The results were excellent.

"During the whole time the patient was about and doing all work that had to be done and no more.

"The symptoms that lasted the longest were pleural pain, pain in the region of the left kidney, and conjunctivitis. Two weeks after the last dose a series of Russian baths alleviated these symptoms so that it might be considered that the crisis was over and improvement was slow but sure. Muscular weakness was still pronounced and general depression also. It was found that after any physical exertion there ensued great pleural pain and extreme fatigue. During the administration the erythrocyte count was reduced one-half million, becoming 5,000,000; the leucocytes increased from 6,500 to

RÉSUMÉ OF COURSE IN CASE OF C. F. B.

| Date | Dose | Ova | Albumin | Symptoms |
|---|---|---|---|---|
| [illegible] | ¼ gr. | Ova hatch after 5 minutes in water. Many present. | 1.5 per cent. Slight hæmaturia. | None. |
| [illegible] | ½ gr. | Ova hatch after 5 minutes in water. Many present. | 1.5 per cent. Slight hæmaturia. | None. |
| [illegible] | | Ova hatch after 3 hours in water. | 1.5 per cent. Slight hæmaturia. | None. |
| [illegible] | | Ova hatch after 3 hours in water. | 1.5 per cent. Slight hæmaturia | None. |
| [illegible] | | Ova hatch after 3 hours in water. | 1.5 per cent. Slight hæmaturia. | None. |
| [illegible] | 1 gr. | Ova hatch after 3 hours in water. | 1.5 per cent. Slight hæmaturia. | Mental depression and oblivion. |
| [illegible] | | Ova hatch after 3 hours in water. | Hæmaturia less. Albumin less than 1 per cent. | Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. |
| [illegible] | | Ova hatch between 24 and 30 hours incubation. | Hæmaturia less. Albumin less than 1 per cent. | Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. |
| 11/8/20 | [illegible] gr. | Ova hatch between 24 and 30 hours incubation. | Hæmaturia less. Albumin less than 1 per cent. | Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. |
| [illegible] | | Ova present. Blue blotches in center. | Albumin—mere trace. Very small hæmaturia, few reds. | Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. And increased. |
| [illegible] | | Ova present. Blue blotches in center. | Albumin—mere trace. Very small hæmaturia, few reds. | Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. And increased. |
| [illegible] | | Ova present. Blue blotches in center. Ova decrease in number. | Reds less. No albumin. | Drowsy feeling accompanied by sense of tenseness in chest, slight coughing and pain in region of kidneys. And increased. |
| [illegible] | [illegible] gr. | Ova decrease in number. | Reds less. No albumin. | Symptoms same. |
| [illegible] | | Ova do not hatch after 48 hours incubation. | Reds less. No albumin. | Symptoms same. |
| [illegible] | | Less ova. | Reds less. No albumin. | Symptoms same. |
| [illegible] | [illegible] gr. [illegible] gr. | Less ova. | Reds decrease. No albumin. | Lethargy, muscular weakness, headache, cough and pain in back. |
| [illegible] | | Less ova. | Reds decrease. No albumin. | Lethargy, muscular weakness, headache, cough and pain in back. |
| [illegible] | [illegible] gr. [illegible] | Less ova. | Reds decrease. No albumin. | Same as above. Aspirin allayed immediate symptoms such as depression sense of fatigue and headache. |
| [illegible] | | Less ova. | Reds decrease. No albumin. | Same as above. Chronic conjunctivitis starts. |
| [illegible] | [illegible] gr. [illegible] 20 gr. | No ova. | No albumin. No blood. | Symptoms intensified. Conjunctiviti, in right eye. |
| [illegible] | [illegible] | No ova. | No albumin. No blood. | Symptoms intensified. Conjunctivitis in right eye. |
| [illegible] | | No ova. | No albumin. No blood. | Symptoms intensified. Conjunctivitis in right eye. |
| [illegible] | | No ova. | No albumin. No blood. | Symptoms intensified. Poisoning, prominent tightness in chest, coughing, headache, severe backache, [illegible] depressions puffing of eyelids and conjunctivitis. |

| Date | Dose | Ova | Albumin | Symptoms |
|---|---|---|---|---|
| 11/23/20 | | No ova. | No albumin. No blood. | Symptoms of S—— R——— poisoning, prominent tightness in chest, coughing, headache, severe backache, muscular weakness, general depression, puffing of eyelids and conjunctivitis. |
| 11/24/20 | | No ova. | No albumin. No blood. | Better — no headache. |
| 11/25/20 | | No ova. | No albumin. No blood. | Better — Lots better. |
| 11/26/20 | | No ova. | No albumin. No blood. | Better — Lots better. |
| 11/27/20 | | No ova. | No albumin. No blood. | Better — Lots better. |
| 11/28/20 | 1½ gr. Aspirin 20 gr. | No ova. | No albumin. No blood. | Weakness, dizziness, apathy, severe conjunctivitis, pain in pleura and left kidney. Bronchial irritation. |
| 11/29/20 | | No ova. | No albumin. No blood. | Weakness, dizziness, apathy, severe conjunctivitis, pain in pleura and left kidney. Bronchial irritation. |
| 11/30/20 | | No ova. | No albumin. No blood. | Weakness, dizziness, apathy, severe conjunctivitis, pain in pleura and left kidney. Bronchial irritation. |
| 12/1/20 | 1½ gr. Aspirin 10 gr. | No ova. | No albumin. No blood. | Symptoms same, and severe diuresis, loss of appetite. |
| 12/2/20 | 1¼ gr. No aspirin. | No ova. | No albumin. No blood. | Symptoms same, and severe diuresis, loss of appetite. |

13,500 and the hæmaglobin remained normal, 95 per cent.

"During the course of treatment the temperature remained normal the whole time.

"In body weight there was a slight decrease amounting to 8 pounds."

Cystoscopy on October 1 revealed a nearly normal bladder with some œdema and lack of clear cut vascularity.

Cystoscopy on January 7, 1921, showed a normal bladder with just the slightest appearance of telangiectasis to the right of the right ureteral meatus. The urine was negative for red blood cells and ova and had been for many preceding examinations.

From the above report we feel quite sure the patient has been cured.

The experience of the British and American Tropical Schools for Medicine has been apparently little short of marvelous with the above treatment. Dr. Charles S. Vivian of Phoenix, Arizona, recently told me, however, of a case under his care uncured that had been treated with intravenous tartar emetic injections by the British Army authorities. A few deaths have been reported from the larger doses.

# A LARGE MYCOTIC EMBOLIC ARTERIOVENOUS ANEURISM OF THE FEMORAL VESSELS

By ROLFE FLOYD, M.D., New York

THIS case is reported because of the large size of the sac, its large venous connection, the fact that, without rupture, it caused initial and pronounced symptoms before the underlying viridans endocarditis was evident, and finally because there was septic endarteritis with a thrombus in the opposite femoral artery establishing the mycotic embolic origin of the aneurism.

The historical steps in the recognition of mycotic embolic aneurisms are somewhat as follows:

First, embolic abscesses of artery walls were recognized in 1844 by Rokitansky (1). Then in 1853 Tufnell (2) definitely recognized the dependence of an aneurism on emboli derived from vegetations on the heart valves.

Twenty years later Ponfick (3) in 1873, published 7 cases and expressed new views about the pathogenesis of the condition. He recognized that the causative endocarditis was regularly acute, usually an acute engrafted on a chronic process, that the aneurisms were usually small, multiple, and frequently found in cerebral or abdominal vessels, that they belonged to adolescence and early adult life and occurred in arteries otherwise normal. He further believed that the damage to the artery wall began on the side next the lumen and worked out, and that thus the intima, elastica, and media were usually broken through and the sac wall was composed of adventitia and new formed layers, either organized thrombus inside or inflammatory tissue outside. He also observed that these lesions usually developed at or just central to points where the arteries divide. All these observations and conclusions have been confirmed by the work of later students on the subject.

Ponfick also believed that the loose areolar tissue of pia and peritoneum offered no accessory support to a weakened arterial wall and so negatively favored its distention, a factor which seems real but not entirely determinant, for these lesions also occur in the comparatively dense tissues of the extremities.

By a peculiar freak of circumstance in one of his first cases, he found a sharp calcified embolus that had pierced the entire artery wall, a lesion apparently of the utmost rarity. This experience led him to consider the production of all embolic aneurism to be mechanical; he searched assiduously for a minute particle of lime in every case, and when he could not find one he believed the erosion of the vessel wall to be due to mechanical pressure of the embolus against the wall, made more effective by the pulsating pressure of the blood stream, a "decubital necrosis" analogous to bedsore formation. He accordingly denied the primary chemical action and infectious nature of cardiac emboli though fully appreciating these qualities in emboli derived from infectious venous thrombi. This mechanical pathogenesis has not been generally accepted although two cases similar to Ponfick's unquestionable one were reported by Thoma (4) in 1889.

In 1887, fourteen years later, Eppinger (5) made an exhaustive study of the subject and, except in one point, his views, added to the accepted ones of Ponfick, form the basis of the present conception of the condition.

In the first place he showed that the same bacteria were present in the fresh cardiac vegetations and in the emboli, and concluded, in contrast to Ponfick's mechanical theory, that the damage to the artery wall was due to inflammatory and destructive changes induced by these bacteria. He accordingly introduced the term *mycotisch embolishe.*

He especially emphasized the rupture of intima and elastica, demonstrated their

torn edges at the sac mouth and considered the rupture of the elastica as a constant feature and a prerequisite in the pathogenesis of the lesion. The media he found usually ruptured but sometimes partly preserved in the sac wall, and the adventitia its only constant component. In recent cases he found the infectious embolus and active septic inflammation of the vessel wall, but in cases of longer standing, where these features were no longer demonstrable, he considered the ruptured edge of the elastica at the sac margin diagnostic and multiplicity of the lesion an added confirmation.

He, however, held a peculiar notion about the way the lesion developed in the vessel wall, namely, that the first step was the development of a septic peri-arteritis in the tissue just outside the vessel opposite the site of lodgment of the embolus, the second step a septic mesarteritis which finally burst into the lumen, like an abscess, first undermining and then rupturing the elastica and intima in the process.

This view has not found general acceptance and its opponents believe that Eppinger was led astray, just as Ponfick was, by encountering a very rare condition in one of his cases, namely a septic embolus of one of the vasa vasorum, and interpreting his other cases on this basis.

Those who oppose Eppinger's view hold that the inflammation begins in the artery wall where the thrombus lies in contact with it and progresses from the lumen outward.

Unger (6), in 1911, wrote an excellent and convincing paper with careful microscopic studies establishing the correctness of this conception. In one of his cases with septic endocarditis there was no aneurism but an ulcerative lesion in the femoral artery just where the profunda comes off, septic inflammation of the vessel wall, local destruction of the intima, elastica, and part of the media, and a septic thrombus adherent to the ulcer partly occluding the lumen of the vessel. This is almost exactly the lesion which the case I report showed in the left femoral artery.

Aneurisms can occur with acute endocarditis in another way. Vegetations may form on the aortic wall, especially in the ascending aorta, just as they form on the valves or on the mural endocardium and the vessel wall beneath them may be ulcerated, weakened, and may pouch into sacculated aneurisms which are mycotic but not embolic. Such are reported by Osler (7), 1885, and McCrae (8), 1905.

Lewis and Schrager (9), 1909, in an excellent review of the subject preliminary to reporting their own cases state that "the case reported by Osler in which one of the aneurisms was as large as a billiard ball is probably the largest embolomycotic aneurism observed." Unger, 1911, however, reports one of the left femoral artery 11 by 10 by 7 centimeters, the largest of which I have been able to find a previous record. The one I am about to describe measured 15 centimeters in length and over 6 centimeters in diameter.

Unger, reviewing the reported cases in 1911, found 91 mycotic-embolic aneurisms of which 8, or nearly 9 per cent, were femoral and situated at the point where the profunda femoris comes off.

Arteriovenous aneurism, on the other hand, appears in the literature as a comparative rarity up until the onset of the late war in 1914, since which many have been reported. Practically all such cases are regarded as due to the simultaneous penetration of an artery and vein where they lie close together by a weapon or projectile. I have, however, found only two cases of embolic-mycotic arteriovenous aneurism described; one by Simmonds (10), 1904, the second by Libman (11), 1907.

Simmonds' was a sacculated aneurism the size of a hen's egg at the aortic bifurcation, which secondarily perforated the right common iliac vein by a hole the size of a lead pencil. It occurred in a woman 31 years old dying of puerperal sepsis without giving pronounced symptoms of the aneurism.

Libman's case was in a man, 25 years old, sick of infectious endocarditis who suffered with pain in the groin for 4 weeks and then developed an elastic swelling in

the left femoral region, painful and tender with expansile pulsation and a loud systolic-diastolic humming murmur with a systolic accentuation. The "left femoral artery showed quite marked endarteritic changes. There was an aneurism at the point where the profunda was given off. The sac contained thrombatic masses, most of which were not at all decolorized. The remains of the vessel wall were present in the sac. The femoral vein had a small deficit in its wall externally and anteriorly which led into the sac." Staphylococcus aureus was found in the sac and streptococcus and staphylococcus aureus in the heart blood. The ordinary aneurism of later life, usually developed in syphilitic vessels, may, however, perforate into a vein, and so produce an arteriovenous aneurism. Such a case came under my care on the 2d Medical Division at Bellevue Hospital in January, 1916. A man with an enormous sacculated aneurism of the ascending aorta was profoundly cyanotic for 2 weeks before death and at autopsy there was found a slit-like opening about 1 inch long from the superior vena cava into the sac.

Following is the record of the case which it is the purpose of this paper to report:

Carpenter, age 36; admitted to Roosevelt Hospital, July 31, 1919, complaining of rheumatism. Five of his brothers have rheumatism, but he had never had it before. He himself had measles, diphtheria, mumps, whooping cough, and frequent sore throat, as a boy. He is subject to attacks of indigestion and vomiting. He has had a right hydrocele for 7 years which has been repeatedly tapped. Otherwise his health has been good. No cardiac or renal symptoms. There is no history of any injury or wound in the right leg or groin. Ten weeks ago he noticed his right ankle was swollen but not painful. A little later he began to have pain all through the leg which was worse when the leg was kept quiet and was relieved by massage. Both the swelling and pain have increased up to the time of admission.

*Examination.* Color and nutrition about normal but he has the face of pain. No pharyngitis; pupils react normally. Lungs are normal. Heart is slightly enlarged, action regular but a little too strong, 100; soft systolic murmur at the apex, transmitted to the axilla. Abdomen is normal; neither the liver nor the spleen is enlarged. There is marked pitting œdema of the whole right leg and right side of the scrotum. There is no evidence of inflammation of the knee or ankle but motion, especiallly extension, of the hip causes much pain. There is a large hard pulsating tumor just below Poupart's ligament over which a distinct systolic thrill is felt, and a systolic and diastolic murmur heard. The tumor is quite tender on pressure. No tumor or pulsation is felt above Poupart's ligament but there is tenderness in this region. There is no œdema elsewhere. Rectal examination is negative. Urine on repeated examinations regularly showed a trace of albumin, never any sugar, rarely a few casts. X-ray showed nothing abnormal in the chest or in the right hip-joint. Blood cultures at first were sterile but at the end of 2 weeks showed streptococcus viridans, a finding which was confirmed by subsequent examinations. Wassermann test on the blood was negative. Blood examinations made on admission and later resulted as follows:

| Hæmoglobin Per cent | White Cells | Polymorphonuclears Per cent |
|---|---|---|
| 60 | 11,800 | 70 |
| 80 | 8,600 | 72 |
| 85 | 7,600 | 68 |

He ran an ordinary septic temperature, usually between 99.5° and 102.5° and never reaching 104°. The pulse was rapid in proportion to the temperature, almost always over 100 and averaging about 110. The respiration ran between 20 and 24.

Although I made the diagnosis of aneurism, probably arteriovenous, on admission, much doubt about the case developed later because it hurt him too much to extend the thigh, and in semi-flexion, and with the general œdema and local inflammation about the sac, it was hard to be clear about the nature of the tumor and much of the time impossible to get any pulsation in it. Added to this came the fact that the diastolic murmur was absent most of the time and the systolic a good part of it. As a result the diagnosis of septic thrombosis of the external iliac vein had more advocates than aneurism when he died on October 21, 11 weeks after coming to the hospital, and 5 months after the appearance of his initial symptoms of swelling of the right leg. The cardiac condition had meantime become increasingly evident not only from the cultures but from cardiac symptoms and conjunctival and cutaneous petechiæ as well.

The autopsy which I performed about 18 hours after death showed: acute endocarditis of mitral and aortic valves; arteriovenous aneurism of right femoral vessels; septic arteritis of left femoral artery; acute exudative nephritis with tubal hæmorrhages, and infarcts; enlarged spleen with infarcts; petechial hæmorrhages of skin and conjunctivæ; œdema and congestion of lungs; double hydrothorax; general subcutaneous œdema especially marked in lower trunk and legs, massive in the right leg; old hydrocele.

The heart showed distinct but not extreme enlargement of the cavities of both ventricles with decided thickening of their walls. Valves of the right side were normal. Mitral valve had huge vegetations of yellow fibrin with recent bloody deposits on both cusps, and there was considerable ulceration with loss of substance of the cusp edges. The aortic valve had a fibrin vegetation 3 millimeters in diameter and 1 centimeter long on one flap which was inflamed and penetrated at the point of attachment of the vegetation; another aortic cusp bore a small recent vegetation, while the third was normal. There was a small mural vegetation on the ventricular endocardium well below the mitral orifice. The muscle wall of the left ventricle was extensively studded with whitish areas which looked like patches of fibrous tissue. Coronary vessels were normal. The pericardium was normal. Under the microscope the heart muscle showed areas of degenerated or absent muscle with a growth of fibrous tissue; pus and round cells infiltrated these areas very irregularly, sometimes practically absent, sometimes quite copious and collected into small foci, but never constituting true abscesses. In two instances a plug of fibrin and pus cells were to be seen inside small vessels penetrating areas of muscle degeneration; in one case the vessel wall was indistinct and evidently damaged. Thus the areas of degeneration seemed to be embolic and the effects of the emboli both mechanical and septic.

The aorta showed only some insignificant patches of ordinary sclerosis.

The kidneys were rather large, with several yellow cortical infarcts; capsules were not adherent; the color a light buff sprinkled with red pin points; cortex of normal relative thickness but its markings obscure; medulla dark red in sharp contrast. Under the microscope small groups of tubes were filled with blood causing the red spots seen in the cortex. The epithelium of the convoluted tubes was mostly somewhat flattened and the tubular lumina enlarged, but there was no exudate in them except for a very moderate amount of coagulated matter, hardly more than normally seen. The glomeruli showed a general but slight increase of the tuft cells obscuring the outlines of the individual capillary loops to some extent. The straight tubes of the medulla were many of them full of blood which accounts in large part for its red color. The capillaries both of cortex and medulla were comparatively empty. The connective-tissue stroma was not increased. Some of the smaller arteries were slightly thickened.

There was a large sacculated aneurism springing from the posterior surface of the right femoral artery in Scarpa's triangle, by an orifice elongated in the axis of the vessel, 2.5 centimeters long and about 0.7 centimeters wide, with smooth edges. The femoral vein lay on the front wall of the sac and there was an opening from the vein into the sac, also elongated in the axis of the vessel, 5 centimeters long. Its edges also were mostly smooth. Thus the openings from artery and vein into the sac lay parallel and side by side, the venous opening having the greater vertical extent. The sac was 15 centimeters long and over 6 centimeters in diameter. It extended up behind Poupart's ligament into the iliac fossa and the ilium was so deeply eroded beneath it that the acetabulum was opened and the head of the femur lay against the sac. The femur, however, showed no erosion. The sac contained clotted blood but no extensive laminated mural clot. There was a good deal of inflammatory tissue, apparently mostly new connective tissue, about the sac so that its dissection was somewhat difficult. There was no appearance of hæmorrhage with false sac wall formation or anything to suggest a dissecting aneurism. The femoral artery showed some sclerosis of the Moenckeberg type with annular depressions of its wall. Unfamiliar with the literature, I failed to look for the torn ends of the intima and elastica at the margins of the sac mouth.

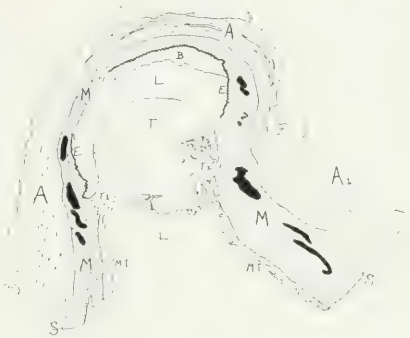


Fig 1. Diagrammatic camera lucida sketch X 30 of a section across the lesion in the left femoral. The artery was split open and the edges of the split, *s* and *s*, spread wide apart in the hardening fluid. *L*, Lumen. There is no intima. The heavy undulating lines, *e* and *e*, represent all that is still traceable of the elastica. The media, *m*, *m*, is thickened by connective-tissue growth and by round-cell infiltration. The solid patches in it are the foci of calcification of Moenckeberg's sclerosis. In places it lies naked to the blood current in the lumen, in places it is covered by elastica, in places it is overlain by thrombi, *mt*. The adventitia *a*, *a*, is normal. At $A^1$ it goes over into the sheath and adventitia of the femoral vein.

The large thrombus, *t*, is quite fibrous at its attachment $T^1$, soft, shaggy, and infiltrated with pus, and round cells are its opposite attachment $T^2$.

The mural thrombi, *m t*, *m t*, probably lay close to or were continuous with the lower edge of the central thrombus before the vessel was opened, the larger portion of lumen and the more normal vessel wall lying above it (in the drawing). Some blood, *b*, settled on the vessel wall postmortem.

In the left femoral artery just below Poupart's ligament there was an ulcerated area, soft and necrotic, about 3 centimeters long to which a large thrombus was adherent which partially occluded the vessel. This artery like its fellow also was the seat of Moenckeberg's sclerosis, a lesion which apparently had nothing to do with either the aneurism or the thrombosis. Under the microscope the artery wall was found infiltrated with round and pus cells; the intima was completely lost; the membrana elastica could be traced through part of the circumference. Deeper in the wall of the media could be seen the lime deposits of Moenckeberg's sclerosis. The thrombus was large and partly filled the lumen; it was attached to the artery wall in two places. Blood vessels penetrated it and fibroblasts were growing in it. On one part of it was a fresh deposit of fibrin and leucocytes. There were a number of phagocytes containing brown pigment in the artery wall and clot margins. A section stained with methyline blue showed no micro-organisms. (See Fig. 1.)

The unusual features of the case then are: (1) The large size of the sac, its wide venous connection, and the density of its wall, preventing its rupture and enabling it to erode bone. (2) The extensive lesion inside the opposite femoral with ulceration and formation of an organizing thrombus but without any aneurismal dilatation. These features appear to depend in part on an infecting organism of low but persistent virulence which allowed time for extensive connective-tissue growth and in fact may have stimulated it. This low virulence is evidenced by the long duration of the illness, the late appearance of cardiac symptoms, the character of the lesions in the muscle wall of the heart as well as of those in the right and left femoral arteries.

I have found some 55 references in the literature bearing on the subject, but only those referred to in the paper are given.

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## GASTRO-ILEOSTOMY

By HARRY COHEN, M.D., New York
Attending Surgeon, Peoples Hospital

REPORTS of gastro-ileostomy performed when gastrojejunostomy had been intended are extremely rare. Only a few are on record. Mercur, after searching the literature up to 1917, cites 2 additional cases and reports 1 which came under his observation. In further search from 1917 to January, 1921, I fail to find any records of similar occurrences. The two other cases cited were described by Judd, of the Mayo Clinic (1912), and Carroll, of Baltimore (1915). A brief résumé of the aforesaid cases follows:

In Judd's and Mercur's patients the anastomosis between the stomach and ileum was 5 and 6 inches proximal to the ileocæcal junction; in Carroll's it was 20 inches. In all the cases the faulty condition lasted from 2 to 3 years before coming under the observation of the above authors. The confirmatory examination in each were the roentgen-rays. The following characteristic symptomatology was present in the three patients: burning sensation in the epigastrium, loss of weight, obstinate constipation, vomiting, nausea, loss of appetite, self-restricted diet, anæmia.

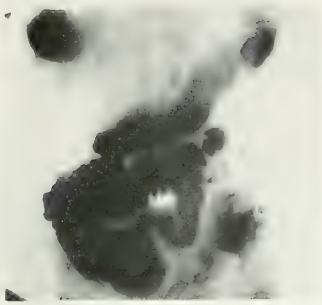

Fig. 1. Roentgenogram of patient standing, immediately after ingestion of barium meal.

In all of these cases the pylorus was found to be patent and normal at the time of the second operation. No evidence of any previous ulcers in the stomach or duodenum was discernable. Owing to this patency of the pylorus the patients were able to survive for 2 or 3 years after the operation inasmuch as some food passed into the small intestine and was digested and absorbed. This patency was demonstrated in all the cases by the roentgenogram. The amount of food which passed through the pylorus, however, was very small, being practically just enough to prevent starvation.

Judd's patient died, probably of acidosis as no apparent pathological reason for death could be discovered at autopsy. Mercur's recovered, convalescence being interrupted by a postoperative ileus which responded to treatment. Carroll's patient recovered without any operative complication.

Mrs. L. W., age 40, Russian, consulted me on February 4, 1919. Her family and personal history were negative. About 4 years ago she developed sharp cramp-like pain in the right upper quadrant of the abdomen. This was constantly present and was neither relieved nor aggravated by the intake of food. The local applications of heat to the abdomen were the ony measure which afforded some relief. The pains increased progressively in severity. There was no vomiting and no hæmatemesis but nausea was a constant manifestation. There was also considerable belching of gas and an occasional feeling of distress in the epigastrium. Jaundice was never noted. These symptoms lasted 2 years during which time she lost about 25 pounds.

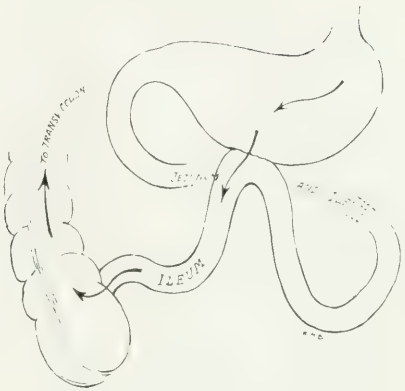


Fig. 2. Drawing of findings in author's case.

In March, 1917, she was operated upon and a gastro-enterostomy performed. She was told that she had had an ulcer of the stomach. She left the hospital in 3 weeks. The previously described symptoms, however, soon returned. There was no relief whatsoever. In addition there was irritability and insomnia. These symptoms continued for 2 years during which time she continued to lose in weight, losing 25 pounds more. Her weight at this time was 85 pounds. During these 2 years she made the rounds of physicians, hospitals, and clinics, everywhere being proclaimed "a neurasthenic." About this time she came under my observation. After considering her symptomatology, a serial roentgenographic study of her gastro-intestinal tract was ordered, and Dr. David J. Hyman, who made the examination, sent me the following unusually interesting report:

"Immediately after the ingestion of a contrast meal, stoma of a gastro-enterostomy was observed, evacuating large amounts of meal which quickly advanced through the terminal coils of the ileum in a diagonal direction to the right, to the region of the cæcum in almost a straight line, about 7 or 8 inches long. A few minutes later the cæcum and ascending colon were entirely visualized. At the end of one-half hour or even less, the colon was visualized up to the splenic flexure and the stoma was four-fifths empty of opaque meal. No food was observed evacuating from the duodenum.

"Plate 1, erect position, shows the stomach rapidly emptying. There is a coil of terminal ileum extending from the stoma to the ileocæcal valve which is constantly full of barium meal, quickly delivering it into the cæcum and colon. The head of the barium column, at this time (10 or 15 minutes after the ingestion of the meal) is two-thirds across the transverse colon, nearly to the splenic flexure.

There is a moderate amount of contrast meal in the jejunum and proximal ileum showing that the pyloric sphincter is patent.

"Plate 2, erect position, and Plates 3 and 4, prone position, show the same condition as Plate 1.

"Fluoroscopic examination, one and one-half hours after the barium meal, shows a moderate amount of barium meal still in the stomach. Head of the barium is near the splenic flexure.

"Plate 5, one and one-half hours after the barium meal, shows the head of barium meal well up near the splenic flexure. The residue observed on fluoroscopy at this time is not shown in the plate on account of the plate being focused too low. The coils of the proximal ileum contain a small amount of barium meal. Fluoroscopic examination, 7 hours after the meal, shows no residue in the stomach, the whole contrast meal, being practically in the cæcum, ascending colon, and transverse colon. There is a small amount of meal in the coils of the proximal and distal ileum which no doubt was evacuated through the pylorus.

"Plate 6, 7 hours after the barium meal, shows this same condition. Fluoroscopic examination at the end of 24 hours shows small remnants of the meal in the proximal transverse colon, none in the descending colon; sigmoid colon and rectum are full of meal.

"Plate 7 shows this condition recorded on the plate. Conclusions: four-fifths of the meal or more is quickly evacuated into the cæcum and transverse colon, practically no digestion taking place; one-sixth of the meal, probably, or less, passes through pylorus and is properly digested."

On February 17, 1919, she was admitted to the People's Hospital where the routine clinical examinations confirmed those already made. Physical examination showed her poorly nourished and emaciated (weight 80 pounds). Her abdomen, except for a high median scar, the result of her former operation, presented nothing pathological.

*Operation — laparotomy.* A median incision was made from the ensiform down to the level of the umbilicus, excising the old scar. On opening the peritoneum, adhesions were found uniting the pylorus and gastrohepatic omentum to the surrounding viscera especially to the liver, gall-bladder, abdominal wall, and to the small intestine. The adhesions were gently separated from the neighboring structures. Exploration of the stomach and duodenum presented no evidence of recent or healed ulcer. The pylorus was patent and admitted the index finger. The gall-bladder, except for being bound down by adhesions, showed no stones or evidence of disease. The previous gastro-enterostomy was found and consisted of a union between the stomach and the ileum, 8 inches proximal to the cæcum. The entire colon and the sigmoid were very much distended. The appendix had been removed at the first operation.

The ileum was cut away from the stomach, and the part of the ileum containing the stoma was resected and an end-to-end anastomosis (McGrath method) was made. This completed the continuity in the ileum. The next problem was the disposition of the stoma in the stomach. Two solutions presented themselves: (1) the closure of the stoma with the restoration of the intestinal canal to normal continuity or (2) performing a gastrojejunostomy. I decided on the latter course because of the large amount of adhesions present about the pylorus, which, although they had been separated, would surely re-form. Consequently the ligament of Treitz was located and the jejunum, about 5 inches away, was brought up to the stoma in the stomach and a posterior gastrojejunostomy performed. The abdominal wall was then closed. Convalescence was interrupted the first 3 days by the development of a postoperative ileus which, however, soon responded to treatment. Several days before being discharged, I excised some very large internal and external hæmorrhoids by the ligature method, using local anæsthesia of quinine and urea hydrochloride and novocaine.

At the time of this report, just one year later, the patient steadily gains in health. Her weight now is 130 pounds, an increase of 50 since the operation. There are no "neurasthenic" symptoms, and she is cheerful and happy. There are no pains in the epigastrium, no nausea, vomiting, and no belching. Her bowels move daily without catharsis. Her appetite is good and her diet is unrestricted.

## SUMMARY

1. These cases are fortunately very rare.

2. The ligament of Treitz is a fixed point high up in the left hypochondrium and should be readily recognized in contradistinction to the ileum which is close to the cæcum, the latter being easily recognizable.

3. Some of the food in my patient passed through the pylorus and small intestines thus allowing just enough nourishment to prevent the patient succumbing from starvation.

4. This patient's symptoms were diagnosed as neurasthenic for 2 years.

5. The same symptoms were present in all the cases reported, viz.: obstinate constipation, burning sensation in epigastrium, loss in weight, and nausea.

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# DEPARTMENT OF TECHNIQUE

## THE RUBIN TEST SIMPLIFIED

By H. DAWSON FURNISS, M.D., F.A.C.S., New York

DR. RUBIN has achieved a notable advance in our diagnostic methods, by demonstrating the patency or non-patency of the fallopian tubes by injection through them of carbon dioxide by way of the uterine canal.

In his routine work he injects from 150 to 200 cubic centimeters of carbon dioxide, and demonstrates its presence in the abdomen by fluoroscopy. In the erect posture the gas is shown as a white line between the diaphragm and the liver or the diaphragm and the spleen. This amount of gas causes a characteristic pain in the shoulder that persists from a few minutes to an hour or more.

His method has been in use on my service at the Post-Graduate Hospital for 2 months. Every case of sterility is so tested, and none is to have any form of operation for sterility until so examined.

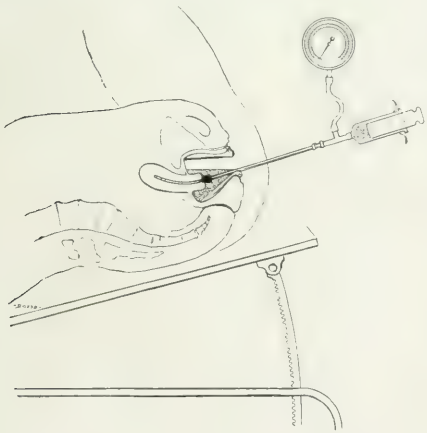

Fig. 1. The cannula is shown passed into the uterus beyond the internal os. The shaded area represents fluid. Should there be an air leak at the external os, it would be appreciated by bubbling in the fluid. The tenaculum used to hold the cervix steady is purposely omitted.

While commending its value, I feel the technique can be greatly simplified. All we wish to demonstrate is the patency of the tubes. This can be done as well with a small amount of gas as with large quantities. With the small amount our patients are spared the shoulder pain.

The capacity of the uterine and tubal cavities has been estimated at about 5 cubic centimeters, although Rubin recently stated he had shown a capacity of 15 cubic centimeters in a uterus and tubes removed by operation. If we inject an amount greater than this maximum without leakage from the apparatus or at the external os, we know that it must have gone into the abdominal cavity.

The apparatus needed for this test is a 30 cubic centimeter syringe that does not leak, a cannula sufficiently long to introduce past the external os, with a rubber urethral tip to prevent escape of gas at the external os, a T connection, manometer to regulate pressure, rubber tubing to make the proper connections, a bi-valve speculum, a vulsellum forceps, and a syringe to fill the vagina with fluid.

The test: The 30 cubic centimeter syringe is filled with carbon dioxide by having the gas from the supply tank displace the piston in the syringe. The flow from the tank should be slow and at low pressure. The patient is put on the examining table, the buttocks elevated, a bi-valve speculum introduced, the cervix

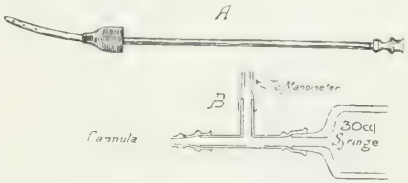


Fig. 2. *a*, Details of cannula and rubber cone; *b*, detail of the T connection.

swabbed with iodine and then grasped on the side with the vulsellum forceps. The cannula is gently introduced and the rubber cone made to fit snugly in the external os. The vagina is then flooded with boracic acid solution so that the external os is covered. The syringe and manometer are then connected. The injection should be slowly made and the pressure as shown by the manometer should not exceed 200 millimeters. Usually in the patent tube cases, the pressure rises to 100 or 120 and then drops to 70–80. If there is any escape of gas at the external os it is readily detectable by the bubbles produced.

This method might be still further simplified by using air instead of carbon dioxide. I doubt very much if the small quantity of slowly absorbable nitrogen would do any damage or even produce discomfort.

## A SUCTION APPARATUS FOR THE TREATMENT OF EMPYEMA

By JOHN W. SNYDER, M.D., Rochester, Minnesota
Special Student, The Mayo Foundation

THE need for a practical type of suction apparatus to be used in the treatment of empyema prompted me to make a device which is simple, readily constructed, and meets the requirements of daily use.

Negative pressure is produced by a common hydraulic suction pump procurable from any instrument dealer. The type we have used (Fig. 1) has a thick rubber ring in one end (Fig. 1, *a*) which may be readily attached to any type water faucet by pushing the ring firmly up around the outlet of the faucet. This obviates special plumbing fittings and permits transportation of the apparatus from room to room. Attaching or detaching the pump requires but a moment's time.

A large bottle with a rubber cork containing three perforations is used as a negative pressure chamber and as a receptacle for aspirated fluids (Fig. 1). Metallic or glass tubes are passed through two of the perforations in the cork, one tube (Fig. 2, *a 1*) reaching just through the cork and the second (Fig. 2,*a 3*) for some distance into the bottle. Through the third perforation an inlet tube having two valves is passed (Fig. 2, *a 2*). The upper valve is automatic in action, working against a spiral spring. The tension of the spring may be varied by means of a thumb screw. The second valve placed below the spring valve may be used to cut off the inlet tube from the vacuum chamber when desired.

The third part of the apparatus is a soft rubber bell which is to be applied to the chest. Such a bell can be easily made from a suction device used by plumbers by removing the handle from the apparatus and drilling a hole through the base of the bell into which a tube is fitted.

Fig. 1. Suction apparatus assembled

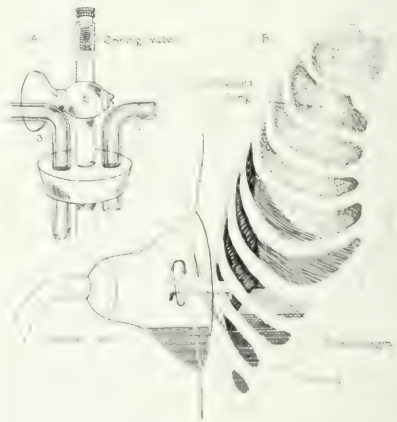

Fig. 2. *a*, Detail of inlet valve; *b*, bell applied to thorax.

Fig. 3. Apparatus in use.

It is also of advantage to thin the edges of the bell slightly to increase its flexibility.

The apparatus is assembled by connecting the suction pump to the shorter tube in the bottle and by connecting the longer tube to the bell by means of rubber tubing. When ready to use, the pump is attached to any convenient water faucet and the water turned on. The bell is held for a few seconds against the chest wall covering the thoracotomy incision and drainage tubes (Fig. 2, *b*). The suction is sufficient to maintain the bell in contact with the chest wall without additional support. It is flexible enough to adapt itself to any surface adhering closely either to an angular or to a rounded type chest.

The degree of negative pressure maintained may be regulated by varying the tension of the spring valve in the inlet tube, for whenever the vacuum exceeds the tension at which the spring is set, air will be admitted to the vacuum bottle. If desired the valve may be standardized against a column of mercury. The rapidity of flow of the water through the suction pump may also be used to regulate the degree of negative pressure.

Patients do not complain of pain with judicious application of the apparatus. The use of "Wolff blow bottles" while the apparatus is in place (Fig. 3) is of aid in expanding the lung of the affected side. Pus and retained secretions are very readily evacuated from the chest cavity. Any degree of hyperæmia may be produced in the wound by varying the degree of negative pressure. The apparatus is also of advantage in the treatment of other types of suppurating wounds, both because of the hyperæmia produced and by the thorough removal of retained secretions. Intermittent irrigation of empyema cavities with Dakin's solution has been employed in all cases in conjunction with the use of this apparatus.

# RADIUM IN CANCER OF THE BLADDER[1]

By GEORGE GILBERT SMITH, M.D., F.A.C.S., Boston
From the Collis P. Huntington Memorial Hospital, Boston

THE treatment of cancer of the bladder by surgical measures alone has, in a rather small proportion of cases, given satisfactory results. In the greater proportion by far, the growth has recurred and all that remained was to ease with morphia the patient's decline. This statement, I think, will be accepted as true by every genito-urinary surgeon of experience.

During the years 1910 to 1915, the acquisition of radium by a number of hospitals and individuals aroused a general interest among urologists as to the value of the element in the management of malignant growth of the bladder. Could radium be used as a substitute for surgery? Was its employment as an aid to surgery productive of results?

In 1916, the Huntington Hospital in Boston began the use of radium in cancer of the bladder. From September, 1916, to January 1, 1921, 24 cases were treated with radium. A number of other cases were seen but not treated, and a few were treated whose later careers were so incompletely recorded that they were of no value as evidence. I shall report today the result of our experiences with these 24 cases.

Very few cases of early carcinoma of the bladder come to the Huntington Hospital. Of the 24 cases in our series, 8 were cases of recurrence after operative removal of a carcinoma; 5 had been operated upon and a growth had been found which was too extensive for removal; 2 appeared after operations for stricture of the urethra; 9 were judged by cystoscopy to be unsuitable for any operation save perhaps the purely palliative procedures of cystostomy and cauterization. There were no benign papillomata in this series, and only one case in which excision of the growth might have been attempted with any success.

Speaking broadly, two types of treatment were used. The earlier method consisted in the application of screened radium emanation to the interior of the bladder, an attempt being made to apply the radium as closely as possible to the region of the tumor. For this purpose, the emanation, in its glass tube, was put into a thin steel needle, and then into a silver capsule with walls 0.5 millimeter thick, carried on the end of of an intra-uterine applicator. The shaft of this was pliable and could be bent in such a way that the capsule at the tip could be applied fairly accurately to that quadrant of the bladder which contained the growth. In other cases, the radium emanation, in a steel needle, in some cases further screened by 0.5 or 1.0 millimeter silver, was placed in the tip of a soft rubber catheter. The catheter was inserted into the bladder and the patient instructed to lie in such position that the catheter would fall toward the affected part of the bladder.

The method which was employed in later cases was the implantation of bare emanation tubes or of steel needles directly into the tumor.

It was first of all necessary to establish a standard dosage, to find, in other words, the number of millicurie hours which might be expected to cause retrogression of the growth, but which would not burn too severely the normal tissues of the bladder. From a series of cases as small as ours, treated by different methods over a term of years, it is difficult to cull the definite information which we would wish upon this point. Furthermore, there appear to be individual variations in the degree of reaction set up in different individuals by the same dosage. The amount of treatment which has already been given, the degree of cystitis, the type of tumor, the mechanical conditions of drainage (whether the urine has to be voided, is drained off suprapubically, or is excluded altogether from the bladder), all these factors influence the action of radium upon the bladder. The amount of screening is, of course, of importance.

I will give a few observations and try to ascertain from them the general limits of dosage.

Case 3 (Tothill). Woman, age 62, had an extensive carcinoma of the left lateral wall and base of the bladder. The growth was sessile and not ulcerated. Eighty-eight millicuries of radium emanation, screened by 2 millimeters silver, was placed in the tip of a soft rubber catheter and left in the bladder for 5 hours, 36 minutes. Total exposure 492 millicurie hours. She remained in the hospital 9 days after the treatment. Her temperature remained normal, and the only evidence of reaction was an increased frequency of urination at night.

Case 15 (Resnick). Woman, age 66, had a sessile, slightly ulcerated growth on trigone. Patient had had several treatments, the last one having been on February 12. April 20 she had no symptoms referable to the bladder. She was given a treatment, 66 millicuries of emanation, screened by 2 millimeters silver, applied to bladder base by means of intra-uterine applicator. The position of the applicator was changed once during the time—4 hours, 34 minutes—it was in the bladder. Total dosage, 300

[1] Presented at a meeting of the American Association for Cancer Research, Cleveland, Ohio, March 24, 1921.

millicurie hours. During the next 3 months, the patient showed no signs of radium burns. Cystoscopy, May 20, showed no burn of normal mucosa but did show retrogression of the tumor.

CASE 18 (Robertson). Man, age 50. March 9, 1920. Cystoscopy; on left side of neck of bladder, extending for 1.5 inches above the internal urethral orifice and covering entire left half of bladder neck, is a massive, solid growth, necrotic in places. March 11, 100 millicuries, screened by 0.5 millimeter silver, screwed on to the tip of an intra-uterine applicator, were applied to the tumor for 3 hours. It was rotated once; dosage 300 millicurie hours. April 1: Since last treatment patient has had no hæmaturia or difficulty in voiding, nocturia four times, has gained 3 pounds. A cystoscopic examination was made and the bladder found not burned. The tumor showed reaction as evidenced by redness and œdema. April 15: cystoscopic examination was made and tumor seemed more extensive. Radium treatment, 66 millicuries, applied as before, for 4½ hours. Dosage 300 millicurie hours. May 20: patient has gained 10 pounds; urinates every 1 to 1½ hours; cystoscopy showed shaggy growth all around bladder neck, extending across trigone on to both lateral walls.

Another case (No. 19) developed considerable bladder irritation after 495 millicurie hours, with 1 millimeter silver and 1¼ millimeters rubber screening.

CASE 21 showed no reaction after 275 millicurie hours, with 0.5 millimeter silver screening.

CASE 22. Woman with a recurrent carcinoma at the bladder neck, had a period of marked bladder irritability after 95 millicuries, screened by 0.5 millimeter silver and a rubber catheter, had been left in the urethra for 2 hours and 5 minutes (200 millicurie hours).

In two cases in which the urine was excluded from the bladder entirely, large doses of radium were applied intravesically. Case 14 had 1,000 millicurie hours with 0.5 millimeter silver screening. Case 20 had 1,008 millicurie hours, with no screening except that of a rubber catheter, inserted into bladder through the suprapubic sinus. Although in both cases the discharge of pus after radiation was annoying, in neither case was there pain in the bladder or any other subjective symptom due to the radium.

From a study of all our cases, of which the preceding instances are fairly typical, it would appear that 400 millicurie hours, given with a screening of 0.5 millimeter or 1.0 millimeter silver, is a dosage which may be used in the treatment of bladder cancer without any very marked reaction. Large doses in bladders which are subject to the alternate diastole and systole of urination, are likely to set up a reaction which is very painful. If the bladder is drained suprapubically, greater doses may be used, and if the urine is entirely excluded from the bladder, doses of 1 000 millicurie hours do not cause discomfort.

The duration of a reaction of moderate severity is from 4 to 6 weeks. Repeating the treatment in less than 6 weeks gives, therefore, cumulative effect. If, however, no reaction has developed in 3 weeks after the first treatment, it is proper to go ahead with the second treatment.

I have found that hæmorrhage and cystitis often decrease after a single radium treatment.

So much for the technical aspect of dosage. The question now arises: What is the effect of repeated or of single doses upon the cancer? Is the application of screened radium emanation to to the surface of the tumor an effective method of treatment?

In our series 15 cases were treated in this way. Six had a total of less than 600 millicurie hours, 9 had 600 or more. I will briefly summarize these 9.

CASE 1 (Wilde), September, 1916. Woman, age 60. August 1916, she had cystostomy by Dr. L. Davis. In the base of the bladder, easily palpable by vagina, was an infiltrating growth, the size of a silver dollar. Through the suprapubic fistula she was given 6 treatments, aggregating 1,900 millicurie hours, with screening varying from only that of the steel needle in which the glass emanation tube was contained, up to 1 millimeter silver. She was given 280 millicurie hours more by vagina. Five months after beginning this treatment, she died. Autopsy showed a sloughing, necrotic bladder, the wall of which contained carcinoma. There were metastases in the abdominal lymphatics and liver. There was a retroperitoneal abscess, a right perirenal abscess, a right pyo-ureter and pyelitis, left hydro-ureter and hydronephrosis. The carcinoma was not destroyed even locally after 2,180 millicurie hours.

CASE 2 (Magnitzky). Woman, age 67, operated upon by Dr. Horace Binney, April, 1916. In October, 1916, she came to the hospital with recurrent carcinoma of the bladder neck. The base of the bladder was indurated over its entire vaginal aspect. She was given 3 intravesical treatments, totalling 848 millicurie hours, with 0.5 millimeter silver screening, and was given 696 millicurie hours over the lower abdomen. She died of carcinoma of the bladder in June, 1917. No autopsy. This was an evidently hopeless case apparently unaffected by radium.

CASE 8 (Ligotte). Man, age 82. July, 1917, cystotomy was done by Dr. Paul Thorndike. Extensive carcinoma of base of bladder was found, and a suprapubic fistula established. In January and February, 1918, he was given two treatments aggregating 1,287 millicurie hours. Steel needles, unscreened, were inserted into the bladder through the fistula. Death from cancer of bladder occurred in September, 1918. This was an advanced case which was unaffected by radium.

CASE 9 (Martin). Man, age 47, who, on December 1, 1917, had a cystotomy by Dr. W. C. Quinby. An extensive growth involving the trigone and left lateral wall of the bladder was found, and suprapubic drainage instituted. Beginning January 19, 1918, the patient had 6 treatments, extending over a period of 8 months. Steel needles containing radium emanation were put into the bladder through his suprapubic tube. A total dosage of 1,785 millicurie hours was given. At no time was there evidence of untoward reaction. Patient died at his home on December 19, 1918.

CASE 11 (French). Man, age 66. November 6, 1917; operation by Dr. G. G. Smith. A malignant growth near right ureter excised, and a rough area on anterior commissure cauterized. Pathological report: cancer. On February 14, 1918, cystoscopy showed an area of rough appearance on anterior commissure, which suggests cancer. March 2, 1918, 204 millicuries, screened only by steel needle and rubber catheter inserted so as to lie just inside bladder orifice. Left in for 3 hours, total 612 millicurie hours. Patient was not seen again, but telephoned that

he was having a great deal of bladder trouble. Died July 3, 1918. No autopsy. A case of localized malignant growth of bladder neck, treated once. In this case 612 millicurie hours proved ineffective in checking growth.

Case 14 (MacBeth). Man, age 61. Bladder full of shaggy growth. Operation, December 3, 1919. Dr. G. G. Smith. Five papillomatous growths were removed, bases cauterized, no apparent induration of bladder wall. Two bare emanation tubes of 8 and 6 millicuries respectively buried in cauterized area outside of right ureter. These total 1,864 millicurie hours. Specimen showed carcinoma. March 18, 1920, cystoscopy; bladder wall smooth except for a necrotic area, 2 centimeters in diameter, surrounded by a zone of heaped up, deep red tissue, outside of right ureter. Given radium treatment, 150 millicurie hours, screening 1 millimeter silver and rubber catheter. May 6, he was given 219 millicurie hours, screened by 0.5 millimeter silver. June 3, he was given 300 millicurie hours, screened by 0.5 millimeter silver. August 28, his symptoms of bladder irritability were worse, and cystoscopy showed papillary masses of necrotic tissue rising from the right lateral wall. His tumor had grown, although he had had 669 millicurie hours radium besides the 1,864 millicurie hours introduced at operation. The neck of the bladder was red and œdematous, evidently a reaction to the radium. A bilateral ureterocolostomy was done in October, 1920. He did well and was given 1,000 millicurie hours, 0.5 millimeter screening, intravesically on November 24, 1920. He then went home to Providence, but a letter received March 12 stated that he was suffering greatly from pain in back and legs and was too ill to be brought to the hospital.

Case 15 (Resnick). Woman, age 66. January 3, 1920. Cystoscopy showed the base of the bladder from above the ureters to the urethral orifice to be covered with a sessile, irregular, non-ulcerated growth. Palpation of base of bladder detects several smooth, firm nodules, the size of beans in the vesicovaginal septum. January 7: 2 bare emanation tubes of 3 millicurie each were inserted into the largest nodules through an endoscope. January 29: bleeding stopped; there is more frequency of urination and some ardor urinæ; cystoscopy shows no appreciable change; 1,155 millicurie hours, screened by 2 millimeters lead applied to base of bladder by vagina. February 11: 730 millicurie hours, screened by 2 millimeters lead, applied by vagina. February 12: 276 millicurie hours, screened by 1 millimeter silver, applied intravesically by means of intra-uterine applicator. March 18: no symptoms now; cystoscopy showed trigone free from growth except for 1 nodule, size of cherry, near right ureter. This mass is palpable by vagina. Close to bladder neck, on right, the mucosa is thickened. April 15: cystoscopy showed on right side of trigone an elevated mass about 1 inch in diameter, with necrotic areas. April 20: 300 millicurie hours screened by 1 millimeter silver introduced into bladder on intra-uterine applicator. May 20: cystoscopy showed 2 nodules near right ureter, small nodule near left; 400 millicurie hours applied by vagina, 2 millimeters lead screening. Nov. 4, 1920: lately has had some frequency and hæmaturia. Cystoscopy showed 2 solid tumors, each about 1 centimeter in elevation and 2 or 3 cen imeters in diameter. Some roughening of the mucosa on right side of trigone. November 30, 1920, cystotomy: a circular growth, 2 centimeters in diameter surrounding left ureter. Into this were inserted 3 bare tubes totalling 20 millicuries. To right of urethra a growth 2 by 0.5 centimeters,in to which were put 3 "seeds," aggregating 11 millicuries. Outside right ureter is a growth 3 by 2 centimeters, 1 centimeter high. This was leveled off with the cautery and into the base were inserted 3 seeds amounting to 22 millicuries. Thus a total dosage of 6,800 millicurie hours was given. The bladder was drained suprapubically for 3 weeks. During convalescence the patient had a good deal of bladder pain. She was discharged January 3, 1921. March 10, 1921: cystoscopy showed great masses of necrotic tissue about the base of the bladder. The ring of growth about the left ureter was gone, leaving a zone of necrosis. The patient was feeling fairly well and her condition was improving.

This case showed very definite improvement following screened radiation from bladder and from vagina. After an initial improvement the growth again became active and was treated by open operation and implantation of bare emanation tubes. Final result as yet unknown.

Case 18 (Robertson). A man of 50 who had had hæmaturia for 2 years. March 6, 1920, cystoscopy: "On left side of bladder extending for 1 or 1½ inches above urethral orifice and occupying entire left side of bladder neck is a massive, solid growth, necrotic in places, apparently continuous with the prostate. Prostate by rectum feels small and soft."

March 11 he was given 300 millicurie hours, 0.5 millimeter silver screening. April 15 this was repeated. Cystoscopy; tumor seems more extensive. May 20: patient has been working and has gained 10 pounds; no hæmaturia; voids every hour or hour and a half. Cystoscopy: shaggy growth all about bladder neck, extending across trigone and on to bo h lateral walls. Ureterosigmoidostomy was done. The patient had postoperative intestinal obstruction. He was explored and a definite obstruction freed, but he died 5 days later. No autopsy could be obtained. 600 millicurie hours did not check the growth.

Case 19 (Boston). Man, age 52. April 12, 1920. Bladder appeared to be full of a shaggy growth. April 15: 495 millicurie hours radium emanation, screened by 1 millimeter silver, contained in soft rubber catheter. Position of the catheter was changed 3 times during the treatment. May 13: has had considerable bladder reaction; now better. June 3, patient working on the road, urine less foul. Cystoscopy: 3 or 4 sloughing papillary growths on left lateral wall and on trigone. Somewhat less growth, less cystitis. June 17, has had to stop work because of bladder trouble. Given 243 millicurie hours, screened by 0.5 millimeter silver. July 8: passes pieces of slough. Base of bladder above prostate feels indurated; much frequency. Operation advised, but patient did not return. A letter states that he died in December, 1920, of cancer of bladder.

Case 24 (Belcher). Woman, age 76. Cystoscopy, June 9, 1920: trigone covered with necrotic growth. Another area back of left ureter. June 8: 91 millicuries, screened by 0.5 millimeter silver, left in bladder for 3.5 hours. Total 300 millicurie hours. July 1: symptoms improved. Cystoscopy: less slough, growth smaller. Ureters now visible. July 15: 99 millicuries radium, screened by 2 millimeters lead, applied to base of bladder from vaginal side for 8 hours. August 19, cystoscopy: trigone apparently free of growth, a few small buds in right base; 152 millicuries, screened by 0.5 millimeter silver, applied to right base of bladder on intra-uterine applicator, for 2 hours. October 7: can hold urine for 2 hours, urine clear. One necrotic papilloma near right ureter. A few buds in right base. October 21: a necrotic growth 2 centimeters in diameter near right ureter. Masses of slough about the bladder neck. November 18: 126 millicuries, screened by

2 millimeters lead, applied by vagina for 4 hours. December 7, growth is increasing, has had 1,900 millicurie hours. December 21, cystotomy: ulcerated area about bladder neck and on trigone. A bit excised. Pathological report: necrosis and inflammatory changes. Some small arteries containing organized thrombi; no carcinoma.

Three bare emanation tubes of 3 millicuries each were inserted—1,200 millicurie hours. Three needles aggregating 44.5 millicuries were left in the tissues about the bladder neck for 24 hours—1,078 millicurie hours. The patient lived for 6 weeks, gradually failing. Autopsy: "Annie Belcher: microscopic notes. None of the numerous sections through the wall of the urinary bladder and neighboring tissue shows carcinoma. There is an acute purulent cystitis, ureteritis (bilateral), and inflammation (acute pyonephrosis) of the kidneys. Lymph-glands show acute inflammation. The bladder wall is considerably thickened by an increase of dense fibrous tissue between the muscle bundles, indicative of long-standing chronic cystitis.

It may have been that in this case the carcinoma had been already destroyed by radium before operation. As a result of two treatments—800 millicurie hours within the bladder, 800 millicurie hours by vagina—a fairly extensive and certainly inoperable growth was almost entirely cleaned up. It began to grow again, howe er, and increased in spite of 300 millicurie hours intravesically and 500 millicurie hours vaginally.

Of the 6 cases treated with less than 600 millicurie hours, none showed improvement worth noting. Of the 15 cases treated by screened radium emanation inserted into the bladder, only 3 showed any marked improvement. This improvement, in Case 19, lasted about 1 month; in Case 15 it persisted for 7 months at least; in Case 24 the cancer may have been destroyed before cystotomy.

The use of screened radium emanation introduced into the vesical cavity, while not wholly ineffectual, was far from encouraging. Although in some cases the amount of treatment was undoubtedly too small, the cases given treatment to the point of burning the bladder were sufficient in number to convince us that a more intimate application of the radium to the tumor was desirable. In our later cases we have, therefore, tried to get the radium directly into the tumor. In 3 cases this was done without opening the bladder; in 3 it was done by cystotomy.

Case 15 has already been described. Two "seeds" were inserted through an endoscope; the number of seeds was inadequate to the size of the growth.

Case 17 (Kettleman). Man, age 67. Cystoscopy, February 17, 1920, showed a large adenomatous prostate. On the anterior vesical wall just behind the anterior commissure of the prostate was a partly necrotic, sessile tumor, about 2 centimeters in diameter. March 3, with cystoscope in the bladder, a long needle bearing in the tip 68 millicuries of radium emanation was inserted through the space of Retzius until the tip could be seen issuing from the tumor. It was then withdrawn slightly and left in position for 3 hours. (Total 204 millicurie hours.) March 18, the tumor had almost disappeared. May 13: no sign of the tumor. I could not see the bladder wall close behind the prostate, so by means of an intra-uterine applicator I applied 138 millicuries, screened by 2 millimeters silver, to the anterior bladder wall for 1 hour, 30 minutes (200 millicurie hours). March 10, 1920: the patient returned for examination. He had gained weight and looked well. He had no bladder symptoms. Cystoscopy showed no sign of tumor in the bladder.

Case 22 (Mrs. Quinn). Woman, age 28, from whose bladder a papillomatous growth the size of a horse-chestnut had been removed at the Boston City Hospital. The operation was on February 28, 1919. June 24, 1920, hæmaturia reappeared. Cystoscopy, July 22, showed a solid, rounded tumor, the size of a marble, rising from right bladder neck. A needle containing 125 millicuries radium emanation was passed through the vesicovaginal septum into the tumor and left for 4 hours—(500 millicurie hours). August 19: tumor reduced one-half; 424 millicurie hours applied by vagina. October 21: endoscopy gives good view of a tumor, size of pea, close to internal orifice. Through the endoscope a needle bearing 28 millicuries was inserted into the tumor, and left for 8 hours (224 millicurie hours). December 2: tumor is gone, white slough at neck of bladder. Patien is 2 months pregnant. February 3, 1921: no growth seen, considerable slough about bladder neck. Patient has had a severe attack of cystitis. February 10, 1921: 95 millicuries, screened by 0.5 millimeter silver, placed in catheter and left in bladder neck for 2 hours, 5 minutes (200 millicurie hours). March 5: patient is having a good deal of bladder distress.

The three cases in which bare tubes were implanted by cystotomy have already been described.

Case 14 had two seeds of 8 and 6 millicuries (1,862 millicurie hours) implanted and 8 months later showed a definite recurrence.

Case 15 had seeds totalling 53 millicuries (7,049 millicurie hours) implanted on November 30, 1920, and 3½ months later showed a great mass of necrotic tissue in the regions so treated. Whether there is still cancer present, cannot yet be told.

Case 24 had seeds and needles implanted totalling 2,278 millicurie hours. At autopsy 6 weeks later no carcinoma could be found.

I am painfully aware of the incompleteness of this series of cases. In many the diagnosis was never made microscopically, although in practically all the diagnosis was made by several cystoscopists. There were but few autopsies upon the cases that died, and as for the few patients still alive, sufficient time has not elapsed to prove the value of this treatment. Certain conclusions, however, have formulated themselves in my mind, to form a starting point for further work.

## CONCLUSIONS

1. It is useless to attempt to cure with radium infiltrating carcinomata which involve large portions of the bladder wall. Necrosis of the

bladder will be brought about by any dosage which will materially influence the tumor.

2. Certain superficial cancers of the bladder may be reduced in extent by the application of screened radium emanation to their surface. This may occur without necrosis of bladder wall.

3. To accomplish this effect, 400 millicurie hours, with screening of 0.5 millimeter silver, applied not oftener than once in 6 weeks, has been successful, and has not caused any considerable reaction in the bladder.

4. The greatest effect is produced by the first 3 or 4 applications of radium.

5. If the tumor begins to grow again, further treatment with radium applications has little deterrent effect.

6. The best way to employ radium in cancer of the bladder is by the implantation of bare emanation tubes in the tumor, allowing one tube to each cubic centimeter. Steel needles containing radium may be employed in the same way, except that they must be withdrawn after adequate exposure has been made.

7. The necrosis caused by the implantation of radium in bladder tumors persists for at least 3 months.

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# THE TREATMENT OF GONOCOCCAL ARTHRITIS WITH ASPIRATED SYNOVIAL FLUID INJECTED INTRAMUSCULARLY

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SOON after the advent of auto-serotherapy, we began its use in the treatment of hydroceles and in gonococcal arthritis where there was an accumulation of synovial fluid. Our experience so far has shown us two outstanding facts in connection with this form of therapy:

1. Little benefit may be expected from it when the hydrocele or synovial fluid is non-infected and free from pus cells, except in the acute traumatic conditions.

2. Prompt improvement and remarkable cures have resulted in all of the patients with acute gonococcal arthritis. Since we began to employ this method of treatment, we have found it unnecessary to resort to any other plan, such as vaccines, sera, local applications, fixation, vesiculotomy, etc.

We desire to report the results in 27 patients treated by this method alone. Restoration to normal has been prompt in all of the acute cases, the relief of pain occurring nearly always within 24 hours. The ultimate results have been equally gratifying: no ankylosis, complete or partial, has followed this plan of treatment. In addition to the improvement in the joints, similar results were noted in the cessation of the symptoms of complicating acute conditions, such as epididymitis, prostatitis, posterior urethritis and seminal vesiculitis. There has been an immediate drop in the temperature in those patients with hyperpyrexia. In one instance the temperature was lowered five degrees in 12 hours.

The treatment is naturally only available for those patients who have a collection of fluid in the synovial space.

The reactions following the injections were usually mild or absent. There was definitely less soreness at the sight of the injections than usually follows an average dose of mixed gonorrhœal vaccine, and in no instance did an abscess form or was there a persisting induration.

All of the injections were given into the gluteal muscles. The piston of the syringe was withdrawn sufficiently to determine that the needle had not entered a blood vessel. These injections were repeated every 2 to 7 days; the amount injected varied from 15 to 50 cubic centimeters. At first the doses were small due to our apprehension; later when we found that no trouble was produced by the injection, the amount was increased. We are now under the impression that the larger doses are the best, in spite of the slight occasional increase in the reaction and the production of chills and a momentary rise in temperature. The average number of injections administered to each patient was three. The fluid, however, was injected as long as there was any of it to be aspirated.

As there is a tendency for the synovial fluid which is left to be absorbed, it is better to repeat the injection every two or three days; although the absorption of the fluid apparently has a beneficial effect it was not to the same extent that was observed when the fluid was injected intramuscularly. The injections were given in the muscle rather than in the subcutaneous tissue because we thought it offered greater resistance to the organisms present in the fluid and that there would be less tendency for abscess formation.

In one patient there was an accumulation in both knees. The fluid was only aspirated from the right one but the left knee subsided with nearly the same promptness as the right.

Since we began the use of this treatment of acute gonococcal arthritis, we have not had occasion to employ any other method of therapy and we are convinced that there is now no other method so uniformly effective.

Practically the same beneficial results followed the injection of hydrocele fluid when the condition was acute and inflammatory; coincident epididymitis, urethritis, and seminal vesiculitis disappearing more quickly than usual.

*Clear sterile fluid.* In only a small percentage of the patients in whom the fluid, either from the joint of the tunica vaginalis, was clear and free from infection, was any of the results satisfactory.

*Acute traumatic synovitis.* Dr. Le Roy W. Childs, who for a number of years has been surgeon for the Athletic Association of the Georgia School of Technology, and who has had considerable experience in the treatment of traumatic joints, in which there was a collection of synovial fluid, has employed the plan of injecting the fluid drawn off, in a series of 16 cases. He states that undoubtedly the patients made more prompt recoveries from these injuries when treated in this manner than did the patients in whom the fluid was merely drawn away and not re-injected.

*Theory as to modusoperandi.* One can see how nature might store antitoxic and antibactericidal substances in this fluid when infection is present, but such a theory would not explain the results of the sterile traumatic conditions. As this is only a preliminary report, we will not enter a discussion as to the process by which these results were obtained, but will take up that phase of the subject in a later communication.

## CASE REPORTS

One case history will be given in considerable detail because it was the result which aroused our interest in this method and because we believe it may elicit the interest of others who may find an opportunity to employ it in other conditions which do not come under our observation or care.

Mr. C. A. F., age 47, lumberman, reported for treatment April 7, 1915, complaining of frequent urination for 8 years which had gradually grown worse until he had to void every 10 to 30 minutes; he had chills, fever, etc., which had been worse since an attack of influenza in January, 1915. He had a tubercular hip since a young man. The urine was so thick with pus and blood that it looked like bloody milk. His voice was husky from tubercular laryngitis. This diagnosis was made by a laryngologist. Tubercle bacilli were found in the sputum and in the urine. There was a hydrocele on the right side and the epididymis was tender and about the size of a large lemon. He stated that this had been swollen for a year and a half and that an abscess had formed 15 months previously. The abscess drained and was followed by a fistulous opening which persisted 6 months.

A cystoscopic examination showed the bladder markedly inflamed with many large, ulcerated areas. The verumontanum was in the bladder cavity as if a large ulcer had destroyed a segment of the internal sphincter. Tubercle bacilli and pus were found in the catheterized specimen of urine from both kidneys.

We decided that there was nothing we could do for him to relieve his condition and advised him to go back to the country where he could get plenty of fresh air, good food and sunshine. Before he left, he asked if we could not do something for the swelling in the scrotum. We informed him that we could tap the hydrocele and momentarily reduce the size of the mass. Then it occurred to us that nature might by some good fortune have accumulated in this fluid some antitoxic substances and so we told him that perhaps some of this fluid re-injected might benefit him and as the prospects seemed utterly hopeless, he was given 18 cubic centimeters of the fluid drawn from the hydrocele which contained enough of pus cells to make it look like cloudy urine. He returned in 2 days and said he was better, that there was less frequent urination and less blood in the urine. He was then given 25 cubic centimeters of the fluid and in 2 days reported that he was a great deal better. The injections were continued every 2 or 3 days for 3 weeks, at which time no more fluid could be obtained. The urine at that time looked like cloudy urine instead of like bloody milk, and the blood had been absent for a week. The epididymis had reduced to about one-fourth its former size and was no longer painful.

There was a rapid gain in weight; the tubercular larynx became normal and no tubercle bacilli could be found in the urine. The urine, however, did not become clear and there were periodic attacks of cystitis.

One year later he returned with a large painful mass in the region of the left kidney. For three weeks there

had been chills and fever and the urine was milky with pus. The mass was found to be a pyonephrotic kidney, which was drained. The kidney on the right side being nearly normal, the left one later was removed. The recovery was normal and there was a rapid gain in weight and strength. The urine soon became clear and there had been no return of the tubercular process. He is in good health, attending to his saw-milling in Southern Alabama. His chief complaint when last seen was that he had gotten too fat for his clothes and that the "profiteers" made it impossible to buy more.

We have seen one other less severe pulmonary tubercular infection with an epididymitis and a hydrocele. The injection of the hydrocele fluid, which contained a few pus cells but no demonstrable organisms, caused a reduction in temperature and a gain in weight, but the epididymitis did not respond to the treatment. An epididymectomy was performed and the fistulous tract incised. Not more than 6 months have elapsed and while he is definitely better, his condition is not normal and we do not think he will obtain a satisfactory result like the first reported.

Case 1. Turk, aged 17, gonorrhœa 4 months; all glasses of urine cloudy; slight urethral discharge; prostate gland enlarged and much pus in the secretion expressed. The right knee had been painful and swollen for 2 weeks. Twenty cubic centimeters of the synovial fluid was aspirated into a sterile syringe and injected into the gluteal muscles. The fluid contained many pus cells but no gonococci could be demonstrated in the stained smear. The patient returned in 2 days with less pain and less swelling in the knee. Twenty cubic centimeters of the fluid was withdrawn and injected. In 2 days more the pain had almost disappeared and only 15 cubic centimeters of the fluid could be aspirated. This was injected into the buttocks. Within 5 days more the knee was practically normal, the urine was clearer although it still contained mucous shreds and pus cells were present in the prostatic secretion. Urethral irrigations and an occasional massage of the prostrate gland soon completed the cure. There was no tenderness at the sight of the injection nor was there an indurated mass.

Case 2. White, male, age 23; gonorrhœa 5 weeks; slight frequency in urination; slight enlargement of the prostate gland; no epididymitis; swelling and redness of the right knee one week ago. Fifteen cubic centimeters of cloudy fluid was aspirated and injected into the buttocks. Within two days the painful symptoms were much better and the ankle less swollen. Twenty cubic centimeters of fluid was aspirated and injected. Five days later he was practically well and there was no fluid to aspirate. Irrigations, prostatic massage, etc., were continued until the urine became clear and the prostatic secretion free from pus cells.

Case 3. Physician, age 29; hyperacute gonorrhœa; enormously swollen left knee; very tender. Profuse urethral discharge, epididymitis and all glasses of urine cloudy; frequent and painful urination; temperature 103°. Thirty cubic centimeters of fluid was aspirated; there were many pus cells in it and gonococci. The fluid was under much pressure in the synovial space. The injection was made as usual and was followed by considerable general reaction and a rise of temperature with chills, aching in other joints much like influenza. Within 24 hours there was a fall of 4 degrees in temperature and a decided reduction in pain. In 48 hours the patient was comfortable, the swelling of the knee greatly reduced, a considerable amount of the synovial fluid having been absorbed during the 2 days following the injection. The patient was then able to walk. Three days after the first injection 40 cubic centimeters of fluid was withdrawn and injected. The second treatment was followed by a slight reaction. In 4 days the remaining fluid, 35 cubic centimeters, was aspirated and injected. In 2 weeks the knee was normal. During this time there was an equally rapid cessation of the urethral symptoms and in the subsidence of the inflammation of the epididymis.

Case 4. Greek, age 24: acute gonorrhœa 4 weeks ago, followed by considerable pain and frequency of urination; no epididymitis. The left knee became red, painful and swollen during the third week. Twenty-five cubic centimeters of fluid was aspirated and injected. The fluid contained pus cells but no organisms could be demonstrated in the stained smear. In four days the patient returned with distinct improvement, less pain, and less swelling in the knee. Thirty cubic centimeters of fluid was again injected and in 4 days 25 cubic centimeters was given intramuscularly. The recovery was uneventful; the reactions were less than those usually occurring after the average doses of vaccine.

Case 5. Male, age 28; gonorrhœa 7 weeks; arthritis left knee three weeks; no complications except prostatitis. The treatment and result were practically the same as in Case 4, except that four injections were given at two-day intervals; recovery was prompt and uneventful.

Case 6. Male, 32; gonorrhœa 1 month; prostatitis and seminal vesiculitis; arthritis of both knees, with considerable swelling. Thirty cubic centimeters of cloudy fluid was withdrawn from the right knee and injected into the gluteal muscles. Three days later he reported with both knees much better and the urgency of urination greatly reduced. The same amount of fluid was aspirated from the same knee and injected. This was repeated in 4 days, after which the recovery was uneventful. It is of interest to note that the fluid from the right knee cured the left one, though the swelling disappeared somewhat more slowly than in the right, which was aspirated.

Case 7. Practically the same as Case 6, except there was seminal vesiculitis, prostatitis, and epididymitis which rapidly subsided along with the cure of the arthritis in the left knee; three treatments being administered.

Case 8. Gonorrhœa 3½ weeks; arthritis right knee and right ankle; two doses 40 cubic centimeters each, from the knee with an interval of 3 days affected a cure in 10 days.

Cases 9 to 27; so slightly do these cases differ from the acute gonococcal ones reported that it is needless to go into details. They were promptly cured in much less time than is ordinarily required and in no instance were supplementary remedies employed.

We believe that the principle involved and the success obtained by this plan of treatment may be logically extended to other conditions where more or less similar processes develop, such for instance as tubercular pleurisy with effusion.

Case 28 is added to those above reported because of its interest as a negative result though it does not properly belong in the group of acute gonorrhœal arthritis, because of its long standing and being non-gonorrhœal in character.

Gonorrhœa was acquired in 1916, followed by prostatitis, chronic. Urine now (2 years later) showed only a few mucous shreds and there was no urethral discharge. Considerable pus was in the prostatic secretion. In a stained smear from a condom specimen there were abundant normal spermatozoa with practically no pus cells. About 1 year ago the right knee became swollen but not very painful; the swelling increased and decreased very rapidly without treatment and was very variable. Much walking made it increase and rest made it decrease in size. Aspirated fluid showed no gonococci but considerable pus and staphylococci. The fluid was different in character from that of patients who had acute gonococcal infections; it was thick and tenacious, looking somewhat like gelatine. This type of arthritis was entirely different from the acute gonorrhœal ones in all of its characteristics and failed entirely to respond to the injections of the aspirated fluid, even after twelve doses of 50 cubic centimeters each. Little reaction, local or general, followed the injections and while slight improvement occurred at times, there were no lasting results. Autogenous vaccine was grown and administered with the same negative results; the reactions, however, were more severe than those from the fluid.

Why this type of arthritis failed to respond as did the acute gonorrhœal ones, we cannot say. Whether other cases more or less similar will fail in the same way, we are unable to state as this is the only one of this kind which has come under our observation.

# EDITORIAL


## SURGERY, GYNECOLOGY AND OBSTETRICS

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NOVEMBER, 1921


## GASTRO-INTESTINAL UNION FOLLOWING PARTIAL GASTRECTOMY FOR CANCER

WHEN Péan, in 1879, performed the first resection of the stomach for cancer he was suddenly confronted with a surgical situation which he met brilliantly, but did not follow. Rydygier, in 1880, performed the second operation and appears to have had a clear idea of what he did and why he did it. To Billroth, the master surgeon, belongs the credit for the first successful radical operation for cancer of the stomach. Billroth, born in Germany of Swedish parents, was a surgeon, a statesman, and a musician, a man of originality and of great learning. He was the father of modern initiative surgery in his conception of the necessity for surgical attack on disease in its earlier and curable stages.

In Billroth's first resection of the stomach for cancer he restored the continuity of the gastro-intestinal tract by direct union of the duodenum to the end of the amputated stomach. This method limited the scope of the operation since if there was a considerable gap between the end of the duodenum and the stump of the stomach, the tension was dangerous, and the angle at the point at which the amputated end of the stomach was reduced to the size of the duodenum often leaked. This point was named "the fatal suture angle." In Billroth's second method these technical defects were overcome by a separate gastrojejunostomy after complete closure of the duodenum and the end of the stomach; this is a preferred operation today.

Kocher modified Billroth's Method I by closing the end of the stomach completely and implanting the end of the duodenum into the posterior wall of the stomach. Kocher tried to overcome the element of tension by mobilization of the upper duodenum, but it proved to be open to the same objections as the Billroth Method I, and could be used only in cases in which the growth was small and close to the pylorus. The same objections applied to resection of the stomach in continuity for cancer. Pólya successfully modified the operation by closing the end of the duodenum and implanting the amputated end of the stomach into the side wall of the upper jejunum and bringing the gastrojejunal anastomosis behind the colon through an opening in the transverse mesocolon. This method had the advantage of eliminating one step in the Billroth II operation. Neither the Billroth II nor the Pólya operation, however, permitted attack on the more extensive growth of the stomach in which, after removal of the diseased portion, there was not sufficient room on the posterior wall for the independent gastro-enterostomy of the Billroth II, or sufficient length to bring the end-to-side anastomosis of Pólya below the transverse

mesocolon. Balfour modified the Pólya operation by bringing the jejunum anterior to the colon, a technical manœuver which is extraordinarily efficient since it permits a satisfactory anastomosis to be made, no matter how small a part of the stomach remains.

Moynihan has recently described a new method of restoring the gastro-intestinal tract after partial gastrectomy which has advantages in the hands of highly skilled technicians. The upper jejunum is divided, the distal end is turned in, and the stump of the stomach applied end-to-side, as in the Pólya method. The proximal jejunal end is then anastomosed to the lateral wall of the attached jejunum below the level of the transverse mesocolon.

The poor general condition of some of the patients, however, renders a radical one-stage operation of any type extremely hazardous. Crile and Lilienthal advocate the two-stage operation, first doing the gastro-enterostomy and after some days removing the diseased portion of the stomach. In debilitated patients this method has great merit because the success of the operation, so far as mortality is concerned, depends largely on a successful gastro-intestinal anastomosis. The two-stage operation, however, has the disadvantage that handling carcinoma of the stomach twice doubles the ever present liability of detaching cancer cells which may graft on the peritoneum, and especially on the site of the ruptured ovarian follicles where ovarian metastasis may develop with such rapidity as to obscure the primary disease. In both the female and the male secondary grafts are prone to occur on the lower sigmoid which may be felt digitally through the rectum as the "rectal shelf" of Blumer. Again, secondary resection does not always permit as careful removal of the glands as the primary operation. Our experience with the two-stage operation has been very favorable so far as mortality is concerned, since practically all of the patients who survived the gastro-enterostomy and gained sufficiently to undergo the resection recovered from the radical operation. A number of patients, however, who could have had a resection primarily, for one reason or another never had the resection after the gastro-enterostomy was performed. The two-stage operation improved mortality statistics by eliminating the bad risks, but it diminished the number of patients who were given the chance of cure.

Peck has made a very helpful suggestion, that the gastro-enterostomy be made first in debilitated patients, and, if the patient's condition seems to warrant it, resection immediately, or if not, completion of the operation at a second stage.

The X-ray and improved methods of clinical diagnosis are greatly increasing the number of patients with cancer of the stomach who come to the surgeon in a curable condition. On a proper choice of the method of restoration of the gastro-intestinal tract much of the success of the operation depends.

William J. Mayo.

# CORRESPONDENCE

## THE SURGICAL PATHOLOGY OF RANULA

### A Correction

*To the Editor:* In an article entitled "Ranula of Branchial Origin," by Louis Carp, of New York, which appeared in the August, 1921, issue of Surgery, Gynecology and Obstetrics I find that both Robert M. Lewis, of Baltimore, and myself are grossly misquoted. The references are to my article, "A Contribution to the Surgical Pathology of Ranula," in Surgery, Gynecology and Obstetrics, 1919, xxix, 447, and to that of Lewis, "A Further Note on the Etiology of Ranula," *ibid.*, 1920, xxxi, 82.

Carp writes: "They (i.e., Lewis and Skillern) are of the opinion that the origin of the ranula and the cyst *is in the sublingual gland* (italics mine). In a previous operation for ranula, Skillern's case had the submaxillary gland removed. Wherefore, he comes to his conclusion by a process of elimination." Closer reading of my article would have shown in the first instance that the notes of the surgeon who performed the primary operation state "the submaxillary salivary gland *as well as the sublingual* were dissected out and the wound was closed"; and secondly, my own statement as follows: "I imagine that much of the confusion that has arisen in the interpretation of the surgical pathology of ranula could be dispelled by restricting the application of the term to the condition described above and illustrated by my case, namely, to *hydrops of the sublingual bursa of Fleischmann.*" In my article is a cut showing the surgical anatomy of Fleischmann's bursa. In Lewis's patient, too, both the submaxillary and the sublingual salivary glands had been removed to do away with the cyst, which also recurred. And Lewis writes: "The findings in my case were almost identical with Skillern's, and I am forced to agree with him in his conclusion that, as has been suggested by Fleischmann and others, some ranulæ arise through disease of the sublingual bursa alone."

Philadelphia P. G. Skillern, Jr

## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

Operative Surgery, for Students and Practitioners. By John J. McGrath, M.D., F.A.C.S. 6th ed., revised. Philadelphia: F. A. Davis Company, 1921.

Diseases of Children Designed for Students and Practitioners of Medicine. By Herman B. Sheffield, M.D. St. Louis: C. V. Mosby Company, 1921.

Mortality Statistics, 1919. Twentieth Annual Report. Washington: Government Printing Office, 1921.

Les Extraits Hypophysaires en Obstétrique et en Gynécologie. By Dr. Léon Pouliot. Paris: L'Expansion Scientifique Française, 1921.

Manual of Operative Surgery. By John Fairbairn Binnie, A.M., C.M.(Aberdeen), F.A.C.S. 8th ed., revised and enlarged. Philadelphia: P. Blakiston's Son & Co., 1921.

Infections of the Hand; a Guide to the Surgical Treatment of Acute and Chronic Suppurative Processes in the Fingers, Hand and Forearm. By Allen B. Kanavel, M.D. 4th ed. Philadelphia and New York: Lea & Febiger, 1921.

Operative Surgery. By Shelton Horsley, M.D., F.A.C.S. St. Louis: C. V. Mosby Company, 1921.

General Pathology; an Introduction to the Study of Medicine, Being a Discussion of the Development and Nature of Processes of Disease. By Horst Oertel. New York: Paul B. Hoeber, 1921.

The American Illustrated Medical Dictionary; a new and complete dictionary of the terms used in medicine, surgery, dentistry, pharmacy, chemistry, nursing, veterinary science, biology, medical biography, etc., with pronunciation, derivation, and definition, including much collateral information of an encyclopedic character. By W. A. Newman Dorland, A.M., M.D., F.A.C.S. 11th ed., revised and enlarged. Philadelphia and London: W. B. Saunders Company, 1921.

A Manual of Midwifery; for Students and Practitioners. By Henry Jellett, B.A., M.D.(Dub. Univ.), F.R.C.P.I., L.M., and David G. Madill, B.A., M.B., B.Ch., B.A.O.(Dub. Univ.), L.M. 3d ed. New York: William Wood & Company, 1921.

Surgical Aspects of Dysentery Including Liver-Abscess. By Zachary Cope, B.A., M.D., M.S.(Lond.), F.R.C.S.(Eng.). London: Henry-Frowde Hodder & Stoughton, 1920.

Die oertliche Behandlung, ihre wissenschaftlichen Grundlagen und praktische Anwendung. By Prof. Dr. Heinrich Braun. 6th ed. Leipzig: Johann Ambrosius Barth, 1921.

Gout. By Llewellyn Jones Llewellyn, M.B.(Lond.). With a Section on Ocular Disease in the Gouty by W. M. Beaumont. St. Louis: C. V. Mosby Company, 1921.

Diathermy, Its Production and Uses in Medicine and Surgery. By Elkin P. Cumberbatch, M.A., B.M. (Oxon.), M.R.C.P. St. Louis: C. V. Mosby Company, 1921.

That Bogey Man the Jew. By G. Frank Lydston, M.D. Kansas City: Burton Publishing Company, 1921.

# AMERICAN COLLEGE OF SURGEONS

## HOSPITAL STANDARDIZATION

FROM REPORT FOR 1921, INCLUDING LIST OF 568 GENERAL HOSPITALS OF 100 OR MORE BEDS IN THE UNITED STATES AND CANADA WHICH MEET THE MINIMUM STANDARD OF THE COLLEGE

THE following pages contain a report on the standardization of hospitals for the year 1921. Since the inception of this movement in 1915, and after the minimum standard was evolved from the combined experience of surgeons, internists, and hospital executives, it has met with increasing recognition, until today 74 per cent of the hundred bed hospitals in the United States and Canada have adopted it.

Surely, the time for debate has passed. It is beside the mark to argue the wisdom of a movement which has enlisted the co-operation of three-fourths of hospital America. Any advance in medicine must begin—and end—with the welfare of the patient. He must be at once the actuating impulse and the final beneficiary. Just so surely as the patient is benefited, so also will be the doctor and the hospital. And, precisely, because the minimum standard was evolved to bring every group in the hospital together to work for the patient, it has created an organization which has resulted in better work for the individual surgeon, internist, hospital superintendent, and nurse.

The minimum standard embodies the basic principles of scientific research. Research begins with securing facts, compiling facts, analyzing facts. This done, research draws tentative conclusions gained from analysis of the facts. These conclusions, if supported by sufficient evidence and corroborated by practice, become known as scientific truths.

This standard consists of a working arrangement by which these same principles of research are applied daily in the hospital for the benefit of the patient. Accurate, adequate case records, modern laboratory equipment manned by skilled technicians—what are these but provisions to marshal the facts before the physician for examination? The monthly clinical staff meeting—what is this but an opportunity to test out the data which the records and laboratories have furnished? Insistence on competent and ethical practitioners—what is this but a guarantee that the interpreters of the facts regarding each patient are skilled medical men, on whose judgment the public has every right to rely? The working formula for this program is the minimum standard which follows:

### THE MINIMUM STANDARD

1. That physicians and surgeons privileged to practice in the hospital be organized as a definite group or staff. Such organization has nothing to do with the question as to whether the hospital is "open" or "closed," nor need it affect the various existing types of staff organization. The word *staff* is here defined as the group of doctors who practice in the hospital inclusive of all groups such as the "regular staff," the "visiting staff," and the "associate staff."

2. That membership upon the staff be restricted to physicians and surgeons who are (a) competent in their respective fields and (b) worthy in character and in matters of professional ethics; that in this latter connection the practice of the division of fees, under any guise whatever, be prohibited.

3. That the staff initiate and, with the approval of the governing board of the hospital, adopt rules, regulations, and policies governing the professional work of the hospital; that these rules, regulations, and policies specifically provide:

a. That staff meetings be held at least once each month. (In large hospitals the departments may choose to meet separately.)

b. That the staff review and analyze at regular intervals the clinical experience of the staff in the various departments of the hospital, such as medicine, surgery, and obstetrics; the clinical records of patients, free and pay, to be the basis for such review and analyses.

4. That accurate and complete case records be written for all patients and filed in an accessible manner in the hospital, a complete case record being one, except in an emergency, which includes the personal history; the physical examination, with clinical, pathological, and X-ray findings when indicated; the working diagnosis; the treatment, medical and surgical; the medical progress; the condition on discharge with final diagnosis; and, in case of death, the autopsy findings when available.

5. That clinical laboratory facilities be available for the study, diagnosis, and treatment of patients, these facilities to include at least chemical, bacteriological, serological, histological, radiographic, and fluroscopic service in charge of trained technicians.

The minimum standard is, in essence, an arrangement by which the hospital can insure its patients the best care known to the science of

medicine. We have shown how it provides an application of the principles of scientific research to the care of the patient—the same principles which the individual doctor or surgeon uses for arriving at a diagnosis. And because medical men the country over were quick to see not only the practical but the scientific basis underlying the minimum standard, they have given it, in increasing numbers, their unqualified support.

It is easy to devise a system of rules which—on paper—is perfect. It is quite another matter to evolve a standard of such simplicity that it stands the test of actual conditions in hospital work. Whether the minimum standard is eminently practicable in the every day administration of hospitals is best answered by the following report:

THE ACCEPTANCE OF THE PROGRAM

In 1918, of the general hospitals of one hundred or more beds in the United States and Canada, 89 met the standard. In 1919, 198 fulfilled the requirements; in 1920, 407, or 57 per cent, met the standard; and this year 568 or 74 per cent of the 761 general hospitals are on the "approved" list.

Further, what has been the experience of other organizations interested in hospital betterment? Manifestly, their reaction toward the program furnishes another reliable index as to its applicability. A decided impetus has been given to hospital standardization by the acceptance and endorsement of the minimum standard by such influential and powerful organizations as the American Hospital Association, the Canadian Medical Association, the Catholic Hospital Association, the Conference Board of Hospitals and Homes of the Methodist Church, the Medical and Surgical Section of the American Railway Association, the Methodist Hospital Association, the Protestant Hospital Association, and numerous state, provincial, and local organizations.

What do hospital superintendents of experience think of the minimum standard after they have seen it in actual operation for a period of years? Quick to recognize its advantages, their endorsements have been numerous. The following quotation from Mr. Frank Chapman, Director of the Mt. Sinai Hospital, Cleveland, serves as a representative example:

"Certainly, the establishment of a laboratory for purposes of check is just as essential in handling human life, as in handling inert commodities. Certainly the recording of a performance is just as essential in a hospital as are the production records of any manufacturing plant. It is undebatable that the only exact way of improving our future performance is on a basis of study of our actual performa nce in the past, and certainly the basis of that study must be as exact as it is humanly possible to make it. Therefore, the establishment of a practice of routine complete case histories is, without a doubt, sound. The desirability, and in fact necessity, of a laboratory is equally undebatable. The necessity for regular staff meetings at which can be discussed, in an impersonal and unbiased way, the performance of that staff, cannot help but be productive of great good to the performance of the whole. Is it not these things and these things alone that the College is asking for in its minimum standard?

"These procedures do not require large expenditures of money, but they do require a very material increase in expenditure of energy and endeavor, and require bringing to the problem of hospital administration an ideal of scientific medical practice that, if followed, cannot help but bring the hospital performance of the country as a whole to a higher plane, than has ever been attained in the past."

As another instance, the following opinion from Dr. Louis H. Burlingham, superintendent of the Barnes Hospital, St. Louis, is presented:

"To reduce the whole problem to its simplest terms, I believe it a self-evident fact that any hospital superintendent would prefer to be connected with a hospital where every patient is guaranteed the best possible care. There is no question that the minimum standard as set forth by the American College of Surgeons contributes markedly toward this end. Therefore, if he has any criticism it can only be that the standard does not perhaps go quite far enough."

Hospital staff-members have been similarly responsive, as is evidenced by this viewpoint from a surgeon, Dr. Irvin Abell, of Louisville, Kentucky:

"Now that the ideals of hospital standardization have been demonstrated to be advisable and attainable and are in process of consummation, the advantages both to the physician and patient are so potent one marvels that the recognition of their need has been so tardy.

"Standardization does not imply commercialism; this would be as objectionable in the medical profession as in the profession of the ministry. But it does imply that all patients, rich and poor, receiving treatment in recognized hospitals will be assured of competent and efficient service fully meeting the requirements and standards which knowledge, experience, and humanitarism demand as the unequivocal right of the sick at the

hands of those to whom their health and well-being are entrusted.

"It applies the great moral force of man's duty to man, which by its appeal to reason as well as to the heart leads the hospital authorities and the doctors practicing in such institutions so to realize the modern addenda to medical and surgical knowledge and so to correlate the work of hospital management with the work of doctors, nurses, and technicians, that the patient is assured of proper and competent treatment in so far as it is humanly possible to secure it."

### THE METHOD AND SCOPE OF THE WORK

The hospital surveys of the College are conducted through a trained corps of hospital visitors, all of whom are graduates in medicine. Their purpose is to explain the minimum standard, to interpret its application to each hospital, and to offer constructive criticism and helpful suggestions to remedy any existent shortcomings. Upon these detailed personal surveys, the College is dependent for an accurate estimate of each hospital's status relative to the minimum standard.

An important adjunct to the work of the hospital surveyors has been the emphasis placed on hospital standardization at the state and provincial sectional meetings of the College. At these meetings conferences are held which are devoted to a discussion of pertinent hospital problems by those intimately connected with hospitals. In addition, the community interest is stimulated at public meetings where the benefits of hospital standardization are portrayed.

In 1920, the general hospitals of one hundred or more beds in the United States and Canada were visited. A complete report of the survey of 1920 is contained in bulletin No. 1, Vol. V, issued by the College in January, 1921. This year particular attention has been directed toward those hospitals which in 1920 either were not included in the list, or which were listed with an asterisk. Hospitals which were fully approved in 1920 were not as a routine visited this year, although in all probability visits to these institutions will be resumed in the future.

In addition, 704 general hospitals of fifty to one hundred beds were visited during the past two years; 306 in 1920 and 398 in 1921. As there are approximately 854 of these smaller hospitals in the United States and Canada, 150 remain to be visited. Of these 704 visited during 1920 and 1921, 176, or 25 per cent of the total number, met the standard. The individual listing of this group of institutions will appear next year.

### THE PROGRAM FOR THE FUTURE

Consequently, the survey of 1922 will be extended to include all general hospitals of fifty or more beds in the United States and Canada. Of these institutions already visited, many showed a working knowledge of the minimum standard and evinced an active desire to cooperate. The percentage of these meeting the standard at their first visit compares favorably with the percentage of hundred bed hospitals which were approved on their first inspection. If proof were needed of the universal application of the minimum standard, the acceptance by the smaller hospitals would furnish it. Stressing only broad fundamentals, the minimum standard molds itself to meet specific needs, nowhere impeding initiative or fettering judgment. Rightly conceived and carried out, it makes the hospital the proved guardian of the community health, rendering scientific service to all.

## LIST OF APPROVED HOSPITALS[1]

### Capacity of 100 Beds and More

The following list contains the names of those general hospitals of one hundred or more beds, in the United States and Canada, which meet the minimum standard. In this list a certain number of the institutions are designated with an asterisk. This group includes those hospitals which, when visited, had adopted the fundamental principles of the minimum standard, but which at that time had not had sufficient opportunity to develop all of them to a degree meriting the fullest approval. The hospitals listed without an asterisk, having instituted these measures at an earlier date, had received the benefits of a longer experience in the workings of the program and consequently a broader conception of its application.

[1]This list is complete only to October 4, when this bulletin went to press. Any subsequent changes, if necessary, will appear in the bulletin on hospital standardization which will appear in January, 1922.

### UNITED STATES

#### ALABAMA

Employees Hospital, T. C. I. & R. R. Co., Birmingham
*Hillman Hospital, Birmingham
Mobile City Hospital, Mobile
South Highlands Infirmary, Birmingham

ARKANSAS

*Logan H. Roots Memorial Hospital, Little Rock
St. Louis Southwestern Hospital, Texarkana
St. Vincent's Hospital, Little Rock

CALIFORNIA

Alameda County Hospital, San Leandro
Children's Hospital, San Francisco
*Franklin Hospital, San Francisco
*French Hospital, San Francisco
*Hospital of the Good Samaritan, Los Angeles
Lane Hospital, San Francisco
Los Angeles County Hospital, Los Angeles
Mary's Help Hospital, San Francisco
Mt. Zion Hospital, San Francisco
*O'Connor Sanitarium, San Jose
Pasadena Hospital, Pasadena
*Providence Hospital, Oakland
St. Francis' Hospital, San Francisco
St. Joseph's Hospital, San Francisco
St. Joseph's Sanitarium, San Diego
*St. Luke's Hospital, San Francisco
St. Mary's Hospital, San Francisco
St. Vincent's Hospital, Los Angeles
San Diego County Hospital, San Diego
San Francisco Hospital, San Francisco
*San Joaquin County Hospital, French Camp
Santa Barbara Cottage Hospital, Santa Barbara
Santa Clara County Hospital, San Jose
Santa Fe Coast Lines Hospital, Los Angeles
Southern Pacific Hospital, San Francisco
*Stanford Hospital, San Francisco
University of California Hospital, San Francisco
White Memorial Hospital, Los Angeles

COLORADO

*Denver City and County Hospital, Denver
Glockner Sanatorium and Hospital, Colorado Springs
*Mercy Hospital, Denver
Minnequa Hospital, Pueblo
*St. Anthony's Hospital, Denver
*St. Francis' Hospital, Colorado Springs
*St. Mary's Hospital, Pueblo

CONNECTICUT

Bridgeport Hospital, Bridgeport
Grace Hospital, New Haven
Greenwich General Hospital, Greenwich
Hartford Hospital, Hartford
Lawrence and Memorial Associated Hospitals, New London
New Haven Hospital, New Haven
St. Francis' Hospital, Hartford
St. Mary's Hospital, Waterbury
St. Vincent's Hospital, Bridgeport
*Stamford Hospital, Stamford
Waterbury Hospital, Waterbury

DELAWARE

Delaware Hospital, Wilmington

DISTRICT OF COLUMBIA

Central Dispensary and Emergency Hospital, Washington
Children's Hospital, Washington
Columbia Hospital for Women, Washington
Freedman's Hospital, Washington
Garfield Memorial Hospital, Washington
George Washington University Hospital, Washington
Georgetown University Hospital, Washington
Providence Hospital, Washington
*Washington Sanitarium, Washington

GEORGIA

Georgia Baptist Hospital, Atlanta
Grady Memorial Hospital, Atlanta
University Hospital, Augusta

IDAHO

St. Alphonsus Hospital, Boise

ILLINOIS

Alexian Brothers' Hospital, Chicago
*American Hospital, Chicago
Augustana Hospital, Chicago
Chicago Lying-In Hospital, Chicago
Children's Memorial Hospital, Chicago
Columbus Hospital, Chicago
Cook County Hospital, Chicago
Evanston Hospital, Evanston
*Frances E. Willard Hospital, Chicago
Grant Hospital, Chicago
Hahnemann Hospital, Chicago
Illinois Central Hospital, Chicago
*Illinois Charitable Eye and Ear Infirmary, Chicago
*John C. Proctor Hospital, Peoria
Mercy Hospital, Chicago
Michael Reese Hospital, Chicago
Presbyterian Hospital, Chicago
Rockford Hospital, Rockford
St. Anne's Hospital, Chicago
St. Bernard's Hospital, Chicago
*St. Elizabeth's Hospital, Chicago
*St. Elizabeth's Hospital, Danville
St. Francis' Hospital, Blue Island
*St. Francis' Hospital, Evanston
*St. Francis' Hospital, Peoria
St. Joseph's Hospital, Chicago
St. Luke's Hospital, Chicago
*St. Mary's Hospital, Cairo
*St. Mary's Hospital, East St. Louis
St. Mary's Hospital, La Salle
St. Mary of Nazareth Hospital, Chicago
*St. Vincent's Hospital, Belleville
South Shore Hospital, Chicago
Swedish Covenant Hospital, Chicago
Wesley Memorial Hospital, Chicago

INDIANA

Indianapolis City Hospital, Indianapolis
Methodist Episcopal Hospital, Indianapolis
Robert W. Long Hospital, Indianapolis
St. Anthony's Hospital, Terre Haute
St. Elizabeth's Hospital, Lafayette
St. Joseph's Hospital, Fort Wayne
St. Margaret's Hospital, Hammond
St. Mary's Hospital, Evansville
St. Mary's Mercy Hospital, Gary
St. Vincent's Hospital, Indianapolis

IOWA

Finley Hospital, Dubuque
Iowa Lutheran Hospital, Des Moines
Jennie Edmundson Hospital, Council Bluffs
Mercy Hospital, Council Bluffs
Mercy Hospital, Davenport
*Mercy Hospital, Des Moines

St. Francis' Hospital, Waterloo
St. Joseph's Mercy Hospital, Dubuque
St. Joseph's Mercy Hospital, Sioux City
St. Vincent's Hospital, Sioux City
University Hospital, Iowa City

KANSAS

*Bethany Methodist Hospital, Kansas City
St. Francis' Hospital, Wichita
St. Margaret's Hospital, Kansas City

KENTUCKY

Good Samaritan Hospital, Lexington
Louisville City Hospital, Louisville
Norton Memorial Infirmary, Louisville
St. Anthony's Hospital, Louisville
*St. Elizabeth's Hospital, Covington
Sts. Elizabeth and Mary Hospital, Louisville
St. Joseph's Hospital, Lexington
St. Joseph's Infirmary, Louisville

LOUISIANA

Charity Hospital, New Orleans
*Hotel Dieu, New Orleans
St. Francis' Hospital, Monroe
T. E. Schumpert Memorial Hospital, Shreveport
Touro Infirmary, New Orleans

MAINE

Eastern Maine General Hospital, Bangor
*St. Mary's General Hospital, Lewiston

MARYLAND

Bay View City Hospital, Baltimore
Church Home and Infirmary, Baltimore
*Franklin Square Hospital, Baltimore
Hebrew Hospital and Asylum, Baltimore
Hospital for Women of Maryland, Baltimore
Johns Hopkins Hospital, Baltimore
Maryland General Hospital, Baltimore
Mercy Hospital, Baltimore
Morrow Hospital, Baltimore
St. Agnes' Hospital, Baltimore
St. Joseph's Hospital, Baltimore
Union Memorial Hospital, Baltimore
University Hospital, Baltimore

MASSACHUSETTS

Boston City Hospital, Boston
Brockton Hospital, Brockton
*Burbank Hospital, Fitchburg
Cambridge City Hospital, Cambridge
Carney Hospital, Boston
Children's Hospital, Boston
City Hospital, Fall River
*Cooley-Dickinson Hospital, Northampton
Holyoke City Hospital, Holyoke
Lawrence General Hospital, Lawrence
Long Island Hospital, Boston
Lowell Corporation Hospital, Lowell
Lowell General Hospital, Lowell
Lynn Hospital, Lynn
Massachusetts General Hospital, Boston
Massachusetts Homeopathic Hospital, Boston
Memorial Hospital, Worcester
Mercy Hospital, Springfield
New England Hospital for Women and Children, Boston
Newton Hospital, Newton Lower Falls
Peter Bent Brigham Hospital, Boston
Providence Hospital, Holyoke
St. Elizabeth's Hospital, Boston
St. John's Hospital, Lowell
*St. Luke's Hospital, New Bedford
St. Vincent's Hospital, Worcester
Salem Hospital, Salem
Springfield Hospital, Springfield
Union Hospital, Fall River
Worcester City Hospital, Worcester

MICHIGAN

Battle Creek Sanitarium, Battle Creek
Blodgett Memorial Hospital, Grand Rapids
Butterworth Hospital, Grand Rapids
Children's Free Hospital, Detroit
Detroit Receiving Hospital, Detroit
Grace Hospital, Detroit
Harper Hospital, Detroit
Hackley Hospital, Muskegon
Henry Ford Hospital, Detroit
Highland Park General Hospital, Highland Park
House of Providence, Detroit
St. Joseph's Hospital, Ann Arbor
St. Mary's Hospital, Grand Rapids
St. Mary's Hospital, Detroit
University Hospital, Ann Arbor
University of Michigan Homeopathic Hospital, Ann Arbor
Woman's Hospital and Infant's Home, Detroit

MINNESOTA

Bethesda Hospital, St. Paul
City and County Hospital, St. Paul
Colonial Hospital, Rochester
Deaconess Hospital, Minneapolis
*Eitel Hospital, Minneapolis
*Fairview Hospital, Minneapolis
Minneapolis General Hospital, Minneapolis
Mounds Park Sanitarium, St. Paul
St. Joseph's Hospital, St. Paul
*St. Luke's Hospital, St. Paul
St. Mary's Hospital, Duluth
St. Mary's Hospital, Minneapolis
St. Mary's Hospital, Rochester
*St. Paul Hospital, St. Paul
*Swedish Hospital, Minneapolis
University of Minnesota Hospital, Minneapolis
Worrell Hospital, Rochester

MISSISSIPPI

Matty Hersee Hospital, Meridian

MISSOURI

Alexian Brothers' Hospital, St. Louis
Barnes Hospital, St. Louis
Children's Hospital, Kansas City
*Christian Church Hospital, Kansas City
*Evangelical Deaconess Home and Hospital, St. Louis
Jewish Hospital, St. Louis
Kansas City General Hospital, Kansas City
Lutheran Hospital, St. Louis
*Mullanphy Hospital, St. Louis
Research Hospital, Kansas City
St. Anthony's Hospital, St. Louis
St. John's Hospital, St. Louis
St. Joseph's Hospital, Kansas City
St. Louis Children's Hospital, St. Louis
St. Louis City Hospital, St. Louis

St. Luke's Hospital, St. Louis
St. Mary's Hospital, Kansas City
St. Mary's Infirmary, St. Louis

MONTANA

Columbus Hospital, Great Falls
Montana Deaconess Hospital, Great Falls
Murray Hospital, Butte
St. James' Hospital, Butte
St. Patrick's Hospital, Missoula

NEBRASKA

*Nebraska Methodist Hospital, Omaha
*Nebraska Orthopedic Hospital and Home, Lincoln
St. Elizabeth's Hospital, Lincoln
St. Francis' Hospital, Grand Island
St. Joseph's Hospital, Omaha
*St. Mary's Hospital, Columbus
University of Nebraska Hospital, Omaha

NEW HAMPSHIRE

St. Joseph's Hospital, Nashua

NEW JERSEY

*Alexian Brothers' Hospital, Elizabeth
Atlantic City Hospital, Atlantic City
Bayonne Hospital and Dispensary, Bayonne
Christ Hospital, Jersey City
Cooper Hospital, Camden
Elizabeth General Hospital, Elizabeth
Hackensack Hospital, Hackensack
Jersey City Hospital, Jersey City
Mercer Hospital, Trenton
Monmouth Memorial Hospital, Long Branch
Morristown Memorial Hospital, Morristown
Mountainside Hospital, Montclair
Muhlenberg Hospital, Plainfield
Newark Beth Israel Hospital, Newark
Newark City Hospital, Newark
Newark Memorial Hospital, Newark
Orange Memorial Hospital, Orange
Passaic General Hospital, Passaic
Paterson General Hospital, Paterson
St. Elizabeth's Hospital, Elizabeth
St. Francis' Hospital, Trenton
*St. Joseph's Hospital, Paterson
*St. Mary's Hospital, Hoboken
*St. Michael's Hospital, Newark

NEW YORK

Albany Hospital, Albany
Bellevue Hospital, New York
Beth Israel Hospital, New York
Beth Moses Hospital, Brooklyn
*Binghamton City Hospital, Binghamton
Broad Street Hospital, New York
Brooklyn Hospital, Brooklyn
Brownsville and East New York Hospital, Brooklyn
Buffalo City Hospital, Buffalo
Buffalo General Hospital, Buffalo
*Buffalo Homeopathic Hospital, Buffalo
*Buffalo Hospital of Sisters of Charity, Buffalo
*Bushwick Hospital, Brooklyn
Carson C. Peck Memorial Hospital, Brooklyn
*Children's Hospital, Buffalo
Clifton Springs Sanitarium, Clifton Springs
Community Hospital, New York
Coney Island Hospital, Brooklyn
*Crouse-Irving Hospital, Syracuse
Cumberland Street Hospital, Brooklyn
Ellis Hospital, Schenectady
*Flower Hospital, New York
Flushing Hospital and Dispensary, Flushing
Fordham Hospital, New York
French Benevolent Hospital, New York
*Good Shepherd Hospital, Syracuse
Gouverneur Hospital, New York
Greenpoint Hospital, Brooklyn
Hahnemann Hospital, New York
Hahnemann Hospital, Rochester
Harlem Hospital, New York
Holy Family Hospital, Brooklyn
Homeopathic Hospital, Albany
Jewish Hospital, Brooklyn
Kings County Hospital, Brooklyn
Lebanon Hospital, New York
*Lenox Hill Hospital, New York
Lincoln Hospital, New York
Long Island College Hospital, Brooklyn
*Manhattan Eye and Ear Hospital, New York
Memorial Hospital, New York
Methodist Episcopal Hospital, Brooklyn
Metropolitan Hospital, New York
Misericordia Hospital, New York
Mount St. Mary's Hospital, Niagara Falls
Mount Sinai Hospital, New York
*Mount Vernon Hospital, Mount Vernon
New York City Hospital, Blackwell's Island, New York
*New York Eye and Ear Infirmary, New York
*New York Foundling Home, New York
New York Hospital, New York
New York Infirmary for Women and Children, New York
New York Nursery and Children's Hospital, New York
New York Orthopedic Hospital, New York
New York Post-Graduate Hospital, New York
New York Hospital for Ruptured and Crippled, New York
New York Skin and Cancer Hospital, New York
*New York State Hospital for Crippled Children, West Haverstraw
*Niagara Falls Memorial Hospital, Niagara Falls
Norwegian Lutheran Deaconess Hospital, Brooklyn
*Oneida County Hospital, Rome
Presbyterian Hospital, New York
Rochester General Hospital, Rochester
Rochester Homeopathic Hospital, Rochester
Roosevelt Hospital, New York
St. Catherine's Hospital, Brooklyn
St. Francis' Hospital, New York
St. John's Brooklyn Hospital, Brooklyn
St. John's Hospital, Long Island
St. John's Riverside Hospital, Yonkers
*St. Joseph's Hospital, Syracuse
St. Luke's Hospital, New York
St. Mark's Hospital, New York
St. Mary's Free Hospital for Children, New York
St. Mary's Hospital, Brooklyn
*St. Mary's Hospital, Rochester
*St. Peter's Hospital, Albany
*St. Peter's Hospital, Brooklyn
St. Vincent's Hospital, New York
Samaritan Hospital, Troy
Sloane Hospital for Women, New York
Staten Island Hospital, Tompkinsville
Syracuse Memorial Hospital, Syracuse
Troy Hospital, Troy
Woman's Hospital, New York
Wyckoff Heights Hospital, Brooklyn
*Yonkers Homeopathic Hospital, Yonkers

NORTH CAROLINA

*Watts Hospital, West Durham

NORTH DAKOTA

Bismarck Evangelical Deaconess Hospital, Bismarck
*Grand Forks Deaconess Hospital, Grand Forks
St. Alexius' Hospital, Bismarck
St. John's Hospital, Fargo
St. Luke's Hospital, Fargo

OHIO

*Aultman Hospital, Canton
Bethesda Hospital, Cincinnati
Christ Hospital, Cincinnati
Cincinnati General Hospital, Cincinnati
City Hospital of Akron, Akron
Cleveland City Hospital, Cleveland
Good Samaritan Hospital, Cincinnati
Good Samaritan Hospital, Zanesville
Grant Hospital, Columbus
Hawkes Hospital of Mount Carmel, Columbus
Jewish Hospital, Cincinnati
Lakeside Hospital, Cleveland
Miami Valley Hospital, Dayton
*Mercy Hospital, Hamilton
Mount Sinai Hospital, Cleveland
*Peoples Hospital, Akron
*Protestant Hospital Association, Columbus
St. Alexis' Hospital, Cleveland
St. Elizabeth's Hospital, Youngstown
St. Francis' Hospital, Columbus
St. John's Hospital, Cleveland
*St. Luke's Hospital, Cleveland
St. Mary's Hospital, Cincinnati
St. Rita's Hospital, Lima
St. Vincent's Hospital, Cleveland
St. Vincent's Hospital, Toledo
Springfield City Hospital, Springfield
Toledo Hospital, Toledo
*Youngstown Hospital, Youngstown

OKLAHOMA

St. Anthony's Hospital, Oklahoma
State University Hospital, Oklahoma

OREGON

Emanuel Hospital, Portland
St. Vincent's Hospital, Portland

PENNSYLVANIA

Allegheny General Hospital, Pittsburgh
Allentown Hospital, Allentown
Altoona Hospital, Altoona
Braddock General Hospital, Braddock
Chester County Hospital, West Chester
Chester Hospital, Chester
Children's Homeopathic Hospital, Philadelphia
Clearfield Hospital, Clearfield
Columbia Hospital, Pittsburgh
Conemaugh Valley Memorial Hospital, Johnstown
Easton Hospital, Easton
*Elizabeth Steel Magee Hospital, Pittsburgh
Frankford Hospital, Philadelphia
George F. Geisinger Hospital, Danville
Germantown Dispensary and Hospital, Philadelphia
Hahnemann Medical College Hospital, Philadelphia
*Hamot Hospital, Erie
Harrisburg Hospital, Harrisburg
Homeopathic Medical and Surgical Hospital, Pittsburgh
Hospital of the Protestant Episcopal Church, Philadelphia
Hospital of the University of Pennsylvania, Philadelphia
Hospital of the Women's Medical College, Philadelphia
Jefferson Medical College Hospital, Philadelphia
Jewish Hospital, Philadelphia
Lancaster General Hospital, Lancaster
Lankenau Hospital, Philadelphia
*Medical, Surgical, and Maternity Hospital of the Women's Homeopathic Association, Philadelphia
Medico-Chirurgical Hospital, Philadelphia
*Memorial Hospital, Philadelphia
Mercy Hospital, Johnstown
Mercy Hospital, Pittsburgh
Mercy Hospital, Wilkes-Barre
Methodist Episcopal Hospital, Philadelphia
Misericordia Hospital, Philadelphia
Moses Taylor Hospital, Scranton
Passavant Hospital, Pittsburgh
Pennsylvania Hospital, Philadelphia
Philadelphia General Hospital, Philadelphia
Philadelphia Polyclinic Hospital, Philadelphia
Pittsburgh Hospital, Pittsburgh
Pottsville Hospital, Pottsville
Presbyterian Hospital, Philadelphia
Presbyterian Hospital, Pittsburgh
Reading Hospital, Reading
*Robert Packer Hospital, Sayre
Sacred Heart Hospital, Allentown
St. Agnes' Hospital, Philadelphia
St. Francis' Hospital, Pittsburgh
*St. John's General Hospital, Pittsburgh
*St. Joseph's Hospital, Lancaster
St. Joseph's Hospital, Philadelphia
St. Joseph's Hospital, Pittsburgh
St. Luke's Hospital, South Bethlehem
St. Margaret's Hospital, Pittsburgh
St. Mary's Hospital, Philadelphia
St. Vincent's Hospital, Erie
Samaritan Hospital, Philadelphia
South Side Hospital, Pittsburgh
*State Hospital for Injured Persons, Ashland
State Hospital of the Middle Coal Fields, Hazelton
*State Hospital of the Northern Anthracite Coal Regions, Scranton
*Western Pennsylvania Hospital, Pittsburgh
Wilkes-Barre City Hospital, Wilkes-Barre
Wills Hospital, Philadelphia
Woman's Hospital, Philadelphia
York Hospital and Dispensary, York

RHODE ISLAND

Rhode Island Hospital, Providence
St. Joseph's Hospital, Providence

SOUTH CAROLINA

Chick Springs Sanitarium, Chick Springs
Florence Infirmary, Florence
Roper Hospital, Charleston

SOUTH DAKOTA

McKennan Hospital, Sioux Falls
*St. Luke's Hospital, Aberdeen

TENNESSEE

Baptist Memorial Hospital, Memphis
Erlanger Hospital, Chattanooga
Memphis General Hospital, Memphis
St. Joseph's Hospital, Memphis
St. Thomas' Hospital, Nashville

TEXAS

Baptist Sanitarium and Hospital, Houston
Baylor Hospital, Dallas
John Sealy Hospital, Galveston
*Parkland Hospital, Dallas
Providence Hospital, Waco
Robert B. Green Memorial Hospital, San Antonio
St. Joseph's Infirmary, Fort Worth
St. Joseph's Infirmary, Houston
St. Mary's Infirmary, Galveston
St. Paul's Sanitarium, Dallas
Santa Rosa Infirmary, San Antonio
Temple Sanitarium, Temple

UTAH

*Doctor W. H. Groves Latter Day Saints Hospital, Salt Lake City
Holy Cross Hospital, Salt Lake City
St. Mark's Hospital, Salt Lake City

VERMONT

Mary Fletcher Hospital, Burlington

VIRGINIA

Hospital Division of the Medical College of Virginia, Richmond
Norfolk Protestant Hospital, Norfolk
St. Vincent's Hospital, Norfolk
University of Virginia Hospital, Charlottesville
Virginia Hospital, Richmond

WASHINGTON

Children's Orthopedic Hospital, Seattle
Columbus Sanitarium, Seattle
*Northern Pacific Hospital, Tacoma
Providence Hospital, Seattle
Sacred Heart Hospital, Spokane
St. Elizabeth's Hospital, North Yakima
St. Joseph's Hospital, Tacoma
St. Luke's Hospital, Spokane
Seattle City Hospital, Seattle
Seattle General Hospital, Seattle
Swedish Hospital, Seattle
Tacoma General Hospital, Tacoma

WEST VIRGINIA

*Charleston General Hospital, Charleston
Kessler-Hatfield Hospital, Huntington
Ohio Valley General Hospital, Wheeling
St. Mary's Hospital, Clarksburg
Sheltering Arms Hospital, Hansford
*Wheeling Hospital, Wheeling

WISCONSIN

LaCrosse Lutheran Hospital, LaCrosse
Luther Hospital, Eau Claire
Madison General Hospital, Madison
Milwaukee County Hospital, Milwaukee
*Milwaukee Hospital, Milwaukee
Mount Sinai Hospital, Milwaukee
Sacred Heart Hospital, Eau Claire
St. Agnes' Hospital, Fond du Lac
St. Francis' Hospital, LaCrosse
St. Joseph's Hospital, Marshfield
St. Joseph's Hospital, Milwaukee
St. Mary's Hospital, Green Bay
*St. Mary's Hospital, Superior
Trinity Hospital, Milwaukee

## CANADA

ALBERTA

General Hospital, Calgary
*General Hospital, Edmonton
General Hospital, Medicine Hat
Holy Cross Hospital, Calgary
*Royal Alexandra Hospital, Edmonton

BRITISH COLUMBIA

Provincial Royal Jubilee Hospital, Victoria
Royal Columbia Hospital, New Westminster
Royal Inland Hospital, Kamloops
St. Joseph's Hospital, Victoria
St. Paul's Hospital, Vancouver
Vancouver General Hospital, Vancouver

MANITOBA

Children's Hospital, Winnipeg
General Hospital, Winnipeg
Misericordia Hospital, Winnipeg
St. Boniface Hospital, St. Boniface

NEW BRUNSWICK

General Hospital, St. John

NOVA SCOTIA

St. Joseph's Hospital, Glace Bay
Victoria General Hospital, Halifax

ONTARIO

*General Hospital, Hamilton
General Hospital, Kingston
Grace Hospital, Toronto
Hospital for Sick Children, Toronto
Hotel Dieu, Kingston
St. Michael's Hospital, Toronto
*Toronto General Hospital, Toronto
Victoria General Hospital, London

QUEBEC

Children's Memorial Hospital, Montreal
Hotel Dieu, Montreal
Jeffrey Hale Hospital, Quebec
Montreal General Hospital, Montreal
Notre Dame Hospital, Montreal
Royal Victoria Hospital, Montreal
*Western Hospital, Montreal

SASKATCHEWAN

City Hospital, Saskatoon
Grey Nun's Hospital, Regina
Regina General Hospital, Regina
St. Paul's Hospital, Saskatoon

# MY EXPERIENCE AS A SURGEON WITH THE STANDARDIZATION PROGRAM[1]

By M. G. SEELIG, M.D., F.A.C.S., St. Louis

COUNTRIES, states, universities, and institutes have their ups and downs of intellectual activity. There was a time several decades ago when Missouri occupied a vanguard position in medical science, and when her roster contained names to conjure with. This statement is made not in order to carry the implication that our state is today in her senescence; it is made rather to introduce the fact that when Missouri was in her greatest medical glory, the art of surgery was practically non-existent. Antisepsis, for example, was not dreamed of at that time. It is reported that during this early period, one of the leaders of St. Louis surgery stated that he had performed five laparotomies, and had to show for them, five graves out in Bellefontaine. Clearly what surgery needed in those days was not a program of standardization but rather in the language of Goethe "more light." This light was needed not only in Missouri, but wherever surgery was practiced.

The light finally dawned; first anæsthesia, then antisepsis, then asepsis, then better nursing, better hospitals, better medical schools, and finally better medical students and graduates. The field of surgery broadened, her cures became more numerous, her possibilities more widely recognized and appreciated, and her material rewards magnified. Just here the trouble began. The political economists teach us that capital is a fluid medium, and that it flows hither and thither where the attraction is greatest. It slowly came about that mounting surgical fees resulted in a numerical increase of surgeons constituting so-called attraction centers for the smoothly flowing current of loose capital. Unfortunately this numerical increase of surgeons was not based on any special fitness to practice surgery. From such a type of development there could be only one result, an overcrowded field run wild with the dank undergrowth and tares of incompetency and commercialism. This is not the occasion nor is there any need to point out these evils in detail. It will suffice to say that five years ago fee splitting and kindred evils were rapidly assuming the proportion of full-fledged stenches.

It goes without saying that the greatest sufferer from these various evils was surgery herself. Her good name and repute, the enviable position that she had won only by the most arduous efforts, dating back to the barber surgeon days of 1500, her integrity as a worthy handmaiden to medicine—all these were in the balance. The lay community also suffered to no less degree. No sick layman is safe in the hands of a commercial surgeon. There is no exception to this rule. No sick layman is safe in the hands of an improperly trained or poorly qualified surgeon. There is no exception to this rule. When the number of commercial surgeons and improperly trained and poorly qualified surgeons becomes large enough, the task of the layman in picking his surgical advisor becomes almost hopelessly difficult. We had about reached this stage when, through the agency of the American College of Surgeons, the program of standardization was initiated.

In detailing to you my own personal experience as a surgeon with this program, let me say by way of explanation that I have not enjoyed the privilege of knowing just what was the fullness of the plan in the remarkable mind of Dr. Franklin Martin, and in the minds of his colleagues and counsellors when they started the American College of Surgeons. The eradication of fee splitting seemed to be one of the outstanding issues, and on this issue I was useless as an aid. This practice has always seemed to me so purely a question of personal morals that I have always regarded it as belonging only to the provinces of the priesthood or the police. My interest in improving the qualification of the young surgeon, on the other hand, has been keen, and I have been privileged for years to indulge this interest through contact with medical students and by humbly insignificant dissertations on medical teaching. It slowly dawned on me, as I am sure it must have dawned on every other teacher, that precepts only too often lost their force and edge, when the young practitioner faced the problems incident to practice. Men possessing all the qualifications of brilliant promise have failed to run true to form, others have thrown the race, and still others have fluked or fouled. These were the facts in the case. It was much easier to recognize them than to apply a remedy.

As I look back over my very short contact and experience with the standardization program of the American College of Surgeons, I begin to

[1] Read before the Missouri State Section Clinical Congress of American College of Surgeons, St. Louis, March 10-11, 1921.

appreciate just what was the thought that I have previously referred to as being in the back of the minds of the organizers of the College. I remember the various statutes suggested and actually enacted to control surgical practice. I recall the birth of various organizations of surgeons aimed at emphasizing the special fitness necessary for membership. I think of various other ill-defined and inarticulate reforms or movements toward elevating surgical practice. And as I call all these pictures to mind I realize clearly how little was accomplished in each instance. The reasons for scanty accomplishment are perfectly simple and I believe that we may assume that the program of the college is based on these reasons.

In the first place activities such as surgery calls into play, can be most safely and most surely regulated from within. By this I mean that the development of the noblest impulses and the creation of the purest traditions must in the last analysis come from the very heart of surgery herself; not from the heart of St. Louis surgery, or Philadelphia surgery, or Ohio surgery, or surgery of the East or West, but from all surgery—in respect to this belief I am an internationalist. Any reform or any movement aimed at the betterment of surgery which is not all embracing in its scope is unequivocally stamped as an insignificant success or a failure.

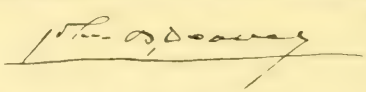
Secondly, the art of surgery lies in remedying or curing surgical disease. The vast majority of surgical cures are purchased. If we hope to safeguard the standard of the commodity we sell, we must educate the layman to the point where he becomes an intelligent purchaser. Again it becomes clearly evident that surgery profits slightly if only the St. Louis, or the Boston, or the New York purchasers are intelligent and discriminating, it profits little even if the city dwellers as a whole display discretion and judgment in selecting their surgeons, as contrasted with a hopeless helplessness on the part of rural invalids. The least the sick man, the world over, can demand, is some legitimate basis of selection on which he may rely in choosing a surgeon.

The program of standardization as I have come in contact with it, is working out along both these lines. Men, conscious of moral or professional limitations barring them from the College, are struggling to correct their defects; recent graduates are planning and so ordering their activities as to furnish warrant for their admission at the earliest moment; the members of the College themselves are consulting the roster more and more frequently when it becomes necessary to refer patients to surgeons away from home, and medical students are beginning to know which of their instructors are members of the College. In other words, one can detect the ferment of the spirit of the guild beginning to work. And it is a sort of universalized chemical reaction, as clearly patent in Texas as in Maine, and in California as in Massachusetts. In other words, the force is coming from within, from the heart of surgery herself. Whatever objection or typically democratic American resentment there might have been against being passed in review before a qualifying board, has given way to the spirit of the movement—better surgeons.

The relationship between the standardization program and the layman is a most interesting one. In most communities the word hospital signifies brick and mortar containers for sick people. It means this not merely to the community at large, but only too frequently to the members of boards of directors themselves. Quite unexpectedly these boards of directors found themselves face to face with an agency which, to use the words of Mr. Bowman, was selling the idea of hospital efficiency. As far as my own experience goes, I can certify to the facts that the idea was sold to them and that they value their purchase. My own board realizes, as never before, what records mean, they are awake to the importance of all varieties of hospital interdepartmental co-operation and they have gone through the period of school boy suspense waiting to see how they would be graded.

What does this mean? It means a beginning of educating the layman to understand and appreciate the real functions of a hospital. Such understanding and appreciation carries with it the corollary that layman will be better able to appreciate and estimate the services of the medical staff. The rendering of adequate medical service begins to take form in the lay mind as a very concrete idea.

To sum up then, in just a word, the program of standardization, as I interpret, has resulted in the first place in stimulating surgery to higher and better efforts. It has done this by a subtle strengthening of *esprit de corps*, and by setting the great body of surgeons to work doing their own house cleaning on an adequately comprehensive scale. In the second place it has resulted in starting the education of groups of laymen, scattered throughout our country. Education is highly infectious, and one may safely hope that knowledge will spread until the average intelligent layman will show at least a glimmer of rationality in selecting his surgeon and in matters pertaining to hospital ideals.



President, American College of Surgeons, 1921

SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXXIII DECEMBER, 1921 NUMBER 6

# SOME TECHNICAL POINTS IN ABDOMINAL SURGERY[1]

BY J. SCHOEMAKER, M.D., THE HAGUE, HOLLAND

BEFORE discussing technique in abdominal surgery, I should like to mention a few words regarding surgical technique in general. Operative surgery is not a sport, it is an art, and just as a violin player plays his sonata with his heart and soul, so the surgeon must perform his operation. This means that the artist does his work not in a hurry, not slowly, but *in tempo*, that he never goes to the next measure before the former is finished and well played, that he never makes a rest where it is not written, that he follows the prescriptions of the composer—for us, the laws of surgical science; but it also means that within these laws he is at liberty to do his work in his own way, striving for perfection and beauty, so that the finished product may be a work of art. But the surgeon is not a solo player; he is the first violin of a quartet, the other members of which are his assistant, his anæsthetist, and his operation nurse. These four must play together as one to produce the ideal result. For such co-operation it is necessary that they be so placed around the operating table that they can always look upon the field of operation—a very essential point—and that they always face each other. For this purpose I arrange my instrument table as shown in Figure 1, and when we are at work no one has to turn his back to the table—not for a moment; we are close together and face each other (Fig. 2).

And now let us go to the technique of abdominal surgery.

## RESECTION OF COLON

Suppose that it is necessary for me to do a resection of the colon. The first great consideration is asepsis. We all know that the colon is full of germs and that it is impossible to make it quite empty. In addition, I wish if possible to do a simple operation; to remove the growth and suture the intestine end-to-end as is done in operating upon the small intestine. If no ileus is present, I should like to do the operation in one stage and leave the intestine in as nearly normal position as possible and so that there will follow no adhesions to the abdominal wall.

The only way to operate aseptically is to suture the gut with the lumen closed; the clamps must remain in place until the suture is complete. But to suture the gut properly I must see the three layers of it, for I want to sew them separately. The technique I use is as follows: After I free the tumor of its adhesions and ligate the mesocolon, I make a circular incision in the intestine through the serosa and the muscular layer but not through the submucosa and mucosa. I push the serosa and muscular layer with the knife to either side, thus making a tube of mucosa upon which I put my clamps. The clamps are placed close together and between the two the intestine is cut (Fig. 3). The clamps I use are very small; they are about the size of a Kocher artery forceps. I have not been successful in using the Kocher forceps for they always slip off unless I leave a fold of

[1] Read before the Clinical Congress of American College of Surgeons, Philadelphia, October 24-28, 1921.

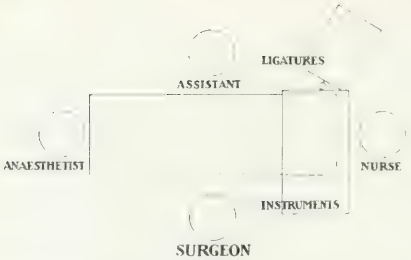



Fig. 1. Drawing showing location of operating table, surgeon, assistant, anæsthetist, nurse, and instrument table.

Fig. 2. Photograph showing same as Figure 1.

mucosa outside the blades, and this is just what I do not wish to do if I am to make an aseptic suture. Therefore, I have modified the forceps by making a deep slit in the blade, and in this slit the fold of mucosa is firmly held.

After the colon is cut at either side of the tumor the ends, which are closed by the clamps, are brought together to be sewed. I begin with the serosa at the back, as a rule using 6 interrupted sutures. Then I suture the mucosa and the border of the muscularis and serosa. I can see the three layers because I have already pushed aside the last two. The clamps are now turned around upon their axes and the suture through the three layers at the front is made over the blades of the clamps. The last stitch cannot be tied until the forceps are taken off. The forceps are removed by the assistant and just at the moment he releases them the knot is drawn tight

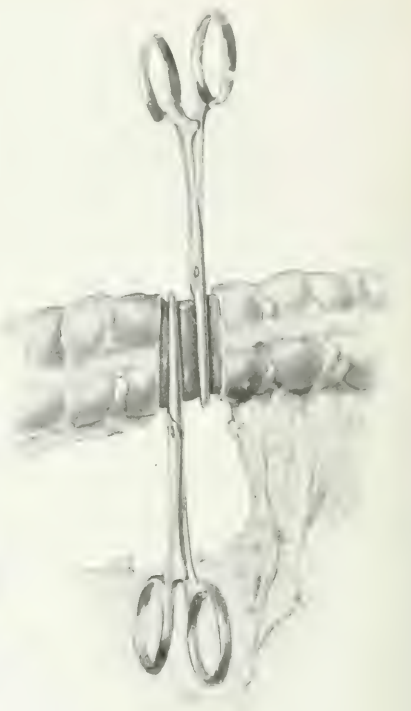


Fig. 3. Position of clamps in performing colectomy.

by the operator (Fig. 5). I suture the serosa with a continuous stitch, and the union of the intestine is complete. During the whole operation the lumen of the colon has not been opened and we have not seen or touched the inner side of the mucosa.

I have performed this operation 40 times for cancer of the colon with 3 deaths. It is remarkable that in these three cases the carcinoma had already extended beyond the intestine and had grown into the surrounding tissue.

I have used the clamps 179 times in removing the cæcum, the ascending colon, and a part of the transverse colon, in cases with pericolitis associated with obstipation. In this

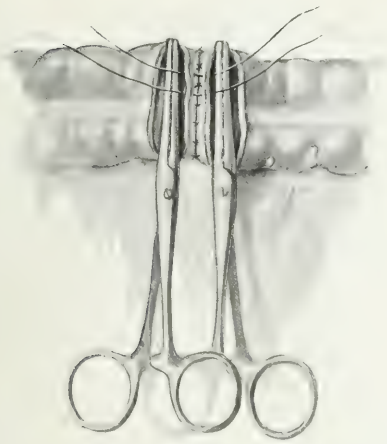


Fig. 4. Placing the sutures in serosa. The serosa, mucosa and border of the muscularis are plainly seen.

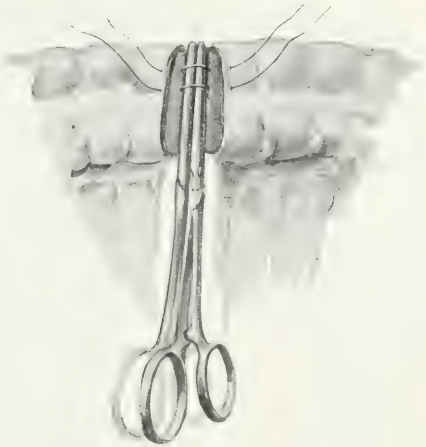


Fig. 5. Suture of the serosa with continuous stitch. Suture of intestine complete.

series I have lost but 2 cases; 1 from pneumonia and 1 from an embolus in an artery of the lung. In these cases I did not make a true colon suture but anastomosed the colon with the ileum. However, this is done in exactly the same manner—I always use the end-to-end suture. This is easily possible with the clamps because I stretch the small intestine perpendicularly to its long axis before I put the forceps on, and at the same time I compress the colon a little so that the one fits the other.

### HEMISPHINCTERECTOMY

I use the same clamps in operating on the stomach. Here the same principles apply. We endeavor to do a simple operation and leave all the organs in as near normal position as possible. So you will readily understand that I am not a fervent advocate of gastro-enterostomy nor of resection according to the Billroth II method. When I am convinced that a spasm of the pyloric sphincter is the cause of symptoms I do a hemisphincterectomy. This is one of the most simple operations one can imagine. The pylorus is grasped between the thumb and forefinger and an incision made in the serosa. The muscle is easily freed. It is cut near the greater curvature, pulled out with a forceps, and again cut near the lesser curvature. The serosa is closed with three or four stitches. This operation is not often indicated, but the few times I have performed it, it has given me full satisfaction (Fig. 6).

### RESECTION OF STOMACH

When I do a resection of the stomach I always use the Billroth I method. It has been said that when a large part of the stomach is resected you cannot bring the stomach stump to the duodenum without producing great tension. I believe this is not true if the correct technique is followed. It is necessary to make the incision in the stomach as is shown in Figure 7. This incision has two advantages: first, it removes the part of the stomach which contains most of the lymph vessels; and second, the remaining part of the stomach forms a tube that is long enough so that it can be sutured to the duodenum without producing tension.

I operate as follows: I begin by freeing the duodenum, placing the ligatures on the vessels of the major and minor omentum, and then I apply one of my small clamps. I place a heavier clamp near the small one, for I want

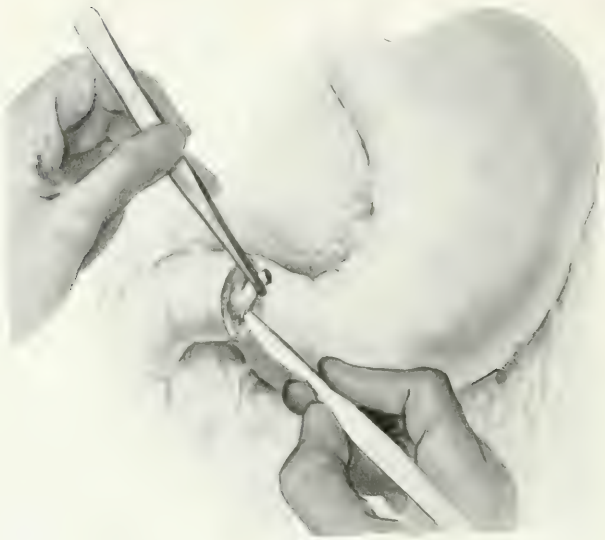


Fig. 6. Technique of hemisphincterectomy.

to exert traction on it. Therefore I leave a strip of the stomach in front of the blades. I cut close to the smaller forceps. The mucosa of the stomach which is thus freed is not so liable to cause infection as is the mucosa of the colon. However, it is better not to let it touch the surrounding tissue or to handle it with the fingers. To avoid contact with the mucosa I put over the clamp a piece of metal which I call a protector. Now I raise the stomach from the abdomen and ligate both ligaments and the attachments, if necessary, at the back. If it is a case of cancer, I ligate the minor omentum as high up as possible; if it is a case of ulcer I ligate a few centimeters beyond the area of infiltration. On the greater curvature I go to the point where I figure the stomach tube must end. Here I apply my colon forceps at right angles to the border of the great curvature. Now I must place a clamp along the curved line which extends from the top of the forceps to the point of the lesser curvature, where I will begin the resection. The clamp I use is somewhat different from the common models, as will be seen from Figure 8. The clamp must serve two purposes: first, it must grasp the stomach so tightly that the stomach cannot slip when I cut it flush

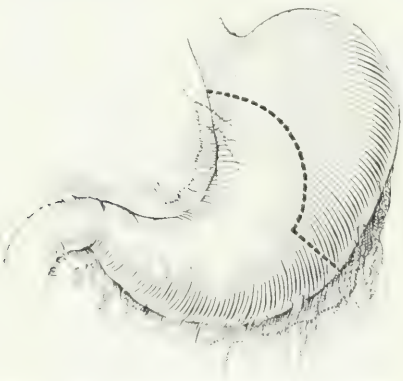


Fig. 7. Line of incision used by author in performing resection of the stomach.

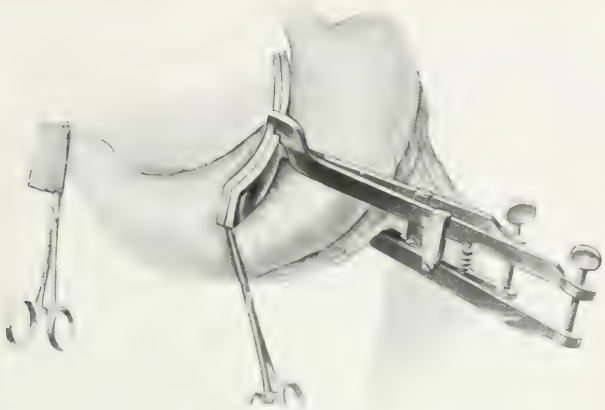


Fig. 8. Clamp used by author in resection of the stomach.

Fig. 9. Exterior part of clamp removed showing fine strip of serosa which is sutured with a continuous suture of catgut.

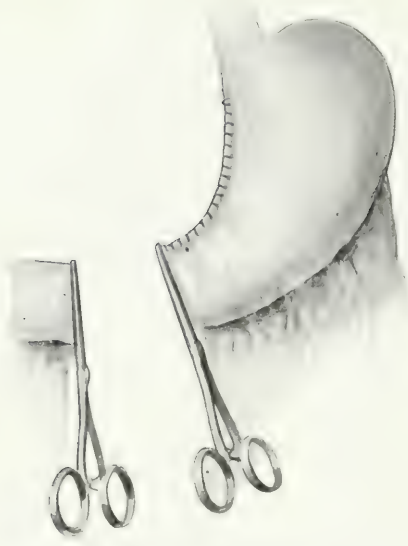


Fig. 10. The stomach tube completed.

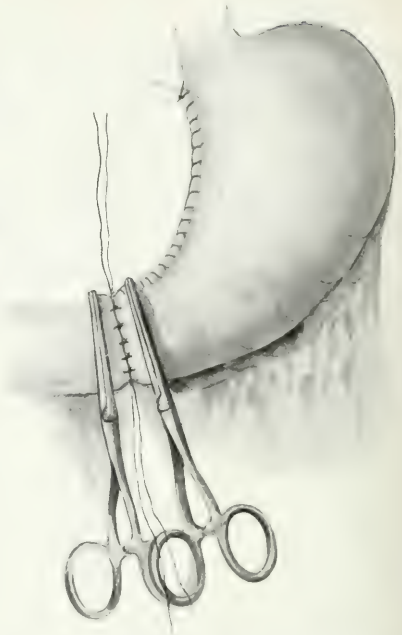


Fig. 11. Union between stomach and duodenum completed.

with the clamp; and, second, the clamp must be so made that it will expose a strip of serosa which I can suture before I remove the instrument. Therefore, the clamp must be heavy and strong and it must be in two parts.

I apply the special clamp and turn both screws very tight. Then, with one or two ordinary clamps, I isolate the part of the stomach that is to be excised and cut with a knife close to the special clamp and the colon forceps. Next I must suture along the curved line. I remove the exterior part of the clamp and this discloses a fine strip of serosa. A continuous catgut suture of the serosa is easily completed (Fig. 9), after which the other part of the special clamp is removed. Next I place over the catgut suture a continuous silk suture of the serosa, and this brings us to the point shown in Figure 10. The stomach tube is now complete and it remains to suture it to the duodenum. This is always easy. The distance from the cardiac end of the stomach to the duodenum in a straight line is less than the length of the tube when it is stretched (Fig. 11). Now I suture the serosa at the back, place an ordinary clamp on the stomach and one on the duodenum, and remove the colon forceps. A circular catgut suture through the three layers and suture of the serosa in front complete the operation.

If the point at which the three sutures meet seems weak, a flap of serosa from the stomach can easily be placed over it and fixed by a single stitch to the duodenum. But this point seldom gives trouble. I have not used the screw clamp often enough as yet to show statistics, but I have done resections many times following the Billroth I method with other clamps, and I am happy to state that I have lost no patient due to leakage of the suture.

# FELLOWSHIP ADDRESS[1]

By SIR HAROLD J. STILES, K.B.E., Edinburgh, Scotland

Regius Professor of Clinical Surgery, University of Edinburgh, President of the Association of Surgeons of Great Britain and Ireland

AMERICA has already been more than generous in making me an Honorary Member of the American Medical Association and of her three chief surgical associations. To occupy a place on the roll of Honorary Fellows of the College of Surgeons of America is an honor of which I am intensely and genuinely proud, and it is one which I and my descendants will treasure for all time as a crowning reward for my surgical endeavors, although I am only too conscious that the honor is out of all proportion to my very humble achievements: rather do I regard it as a gracious compliment to the famous University to which I have the honor to belong, and as a generous recognition of the great traditions of the Surgical School from which I have descended. I am particularly proud that the honor you have just conferred on me should have been received in the city of Philadelphia, the birthplace not only of the oldest medical school in the United States but also of the one which I believe has more Edinburgh blood in its veins than can be traced in the pedigree even of Columbia and Harvard.

The War of the Revolution was the making of Morgan and Shippen, two of the greatest pioneer surgeons of the eighteenth century, both Philadelphians and both Edinburgh graduates. Physick, who was Professor of Surgery in the University of Philadelphia in the early part of last century, and who has often been spoken of as the father of American surgery, was also educated in Edinburgh. Then, again, we have Samuel Gross, said by some to be the father of modern American surgery. He played the same rôle in Philadelphia that Syme did in Edinburgh. They had much in common: both were good anatomists and pathologists as well as great surgeons: both were great diagnosticians and great teachers, and both had the art of inspiring and of winning the affection of their pupils. Although Gross was not an Edinburgh graduate he visited Edinburgh when Syme and Simpson were at the height of their fame.

Gross has always occupied a warm place in my heart particularly on account of his admiration for Sir Astley Cooper. Dr. Finney, in one of his admirable addresses, says: "Teachers in medical schools should not only instruct their pupils but should instill into them by precept and example the right spirit toward their profession and the right attitude toward their patients," and this Sir Astley Cooper surely did. My grandfather, who lived to the age of 96, wrote of his great master, Cooper: "It would be an act of ingratitude did I omit to pay a tribute of respect to the memory of my distinguished anatomical and surgical teacher, Sir Astley Cooper. He did not owe his distinction to exalted rank or to privileges attached to high birth, but rose by the honorable exertion of his native energies, and ultimately attained the most exalted preeminence; indeed, became one of the most illustrious surgeons that ever adorned the science he professed. To Sir Astley Cooper I am indebted, more than to any other man that ever lived, not only for the greater share of anatomical and surgical knowledge I possess but for the privilege of witnessing in him the enthusiasm which filled his soul with an ardor and love of his profession, which incited in me a noble emulation to imitate his praiseworthy example. He stimulated me to exertion—stimulated me in the acquirement of knowledge." Incidentally, I may say that it was through the references in my grandfather's autobiography to Sir Astley Cooper that I myself became fired with the ambition to become a surgeon.

Gross, in this autobiography, said: "I learned my first lessons in surgery from Sir Astley Cooper's Lectures, reprinted in Philadelphia soon after I began the study of medicine. Every student should read them, for they abound in good sense and sound practical knowledge." The same remark

[1] Presented before the convocation of American College of Surgeons, Philadelphia, October 28, 1921.

would apply to Syme's *Principles of Surgery*. On visiting St. Paul's Cathedral, Gross expressed his delight at seeing there a statue to Sir Astley, but took the occasion to deplore the absence of similar memorials in America to inspire our youth with ambition—a grievance which the American Surgical Association so wisely and generously removed after the death of Gross by erecting in Washington a statue to his memory. Syme, Lister, Gross, Keene, Murphy, and many others have had the same inspiring influence as Cooper over their pupils.

The Edinburgh School of Surgery, to which you have paid a tribute in honoring one of its teachers, dates back to 1505, when the Town Council granted the Corporation of Surgeons and Barbers permission to dissect the body of one condemned man in the year. The English Company of Barber-Surgeons did not receive their charter until 35 years later.

The oldest minute-book in the possession of the College of Surgeons contains, on its first page, a prayer by the famous Scottish reformer, John Knox, and, if you will allow me, I will quote it, as it has since been read by the Secretary at the opening of every meeting of the College: "O eternal God, and our loving and mercifull Father in Christ Jesus, seeing we are conveenit heir to treat upon these things that concernis our calling, we beseik thee, O Lord, to be mercifull to us, and giff us grace to proceid thereintill without malice grudge or partialitie; sua that the things we may do may tend to the glorie of God, the weill of our vocation, and confort of every member of the samen; throw Jesus Christ, our only Lord and Saviour; Amen."

The next step in the evolution of the Edinburgh School consisted in the creation of the Museum of the College, which is one of the finest collections in Europe. In 1703, the Incorporation of Surgeons erected an anatomical theater, and, two years later, Robert Eliot was appointed first professor of anatomy in the Town's College, which had received its charter from James VI in 1582.

John Monro, a Fellow of the College of Surgeons, whose ambition it was to found a Medical School in Edinburgh, sent his son, Alexander, to study Anatomy and Surgery in London, Paris, and Leyden. In 1720, Alexander Monro was appointed to the chair of anatomy: a few years later, 1725, he transferred his teaching to the University, and the following year saw the establishment of a Medical Faculty.

Of Alexander Monro, primus, it can truly be said that he was "the father of the Edinburgh Medical School," and, although he was more anatomist than surgeon, Edinburgh surgery owes him an everlasting debt of gratitude for being the moving spirit, along with Lord Provost Drummond, in founding the Royal Infirmary, which soon developed into one of the most famous schools of clinical teaching in the world.

Previous to the establishment of a Faculty of Medicine in the University of Edinburgh, anatomy had been taught by private lecturers belonging to the Incorporation of Surgeons. These men were really the pioneers of the Edinburgh Extramural School.

What is now known as the Old Royal Infirmary, where Lizars, Fergusson, Liston, Syme, and Lister did their epoch-making work, was opened in 1741. It contained 228 beds, and a single operating-theater accommodating 200 students.

Before 1833, when Syme became professor of clinical surgery in the University, the Edinburgh School of Surgery was rendered famous by Benjamin Bell, whose six-volume *System of Surgery* was translated into French and German, and by the brothers John and Charles Bell, both great surgeon-anatomists. The latter was also an epoch-making physiologist, his discovery of the functions of the spinal nerve roots entitling him to rank second only to Harvey. Charles Bell migrated to London, to return to Edinburgh later as professor of systematic surgery. While in London, he taught anatomy at the well-known Great Windmill Street School, where he accumulated a number of valuable specimens, now in the Museum of the College of Surgeons of Edinburgh. Both he and his brother John were endowed with great artistic talent, and the water-color drawings of Sir Charles Bell, of gunshot

wounds, the result of his experience at Waterloo, are classical.

The fame of the Edinburgh School of Surgery in the first half of the last century was largely due to the surgeon-anatomists of the Extramural School. Principal Sir Alexander Grant, in his historical volume entitled *The Story of the University*, gives full credit to the important rôle played by the extramural lecturers in the evolution of the Edinburgh Medical School, and remarks that "one of its greatest advantages has been that the University has continued to be surrounded by extramural rivals who have kept its professors up to the mark and sometimes eclipsed them, and who have always been in training to fill up the ranks of the University whenever vacancies occurred." My colleague, Mr. Miles, in his admirable little book on *The Edinburgh School of Surgery before Lister*, makes the further observation that "In another direction, the extramural teachers have played an important part in guiding the destinies of the medical school. Free from the bonds of statutes and ordinances, they have always been able to lead the way into developing instruction in special branches of knowledge, and many of the specialists that are now represented within the University originated in the Extramural School."

The Chair of Clinical Surgery which I have now the honor to occupy was founded by George III, in 1803. The first occupant was James Russell, who enjoyed the intimate friendship of Sir Walter Scott. On his resignation, Liston and Syme contested the vacancy. The latter was appointed, and became the greatest teacher of his generation. He died in 1870, shortly after his son-in-law, the immortal Lister, who succeeded him, had initiated the new era in surgery. A few years later, Liston accepted the Chair of Clinical Surgery at University College Hospital, London.

Robert Liston was perhaps the most famous of all the anatomical surgeons in the Edinburgh School. Before he was appointed to the staff of the Edinburgh Royal Infirmary, he was performing, with the assistance of Syme, operations more formidable than those which were undertaken in the Infirmary. He is well known to us all as the introducer of the transfixion method of amputation, and as being the surgeon who performed the first major operation in London under ether, in 1846. The operation was an amputation through the thigh. There was a dispute between the time-keepers as to whether it took 25 or 28 seconds to remove the limb. The patient was in the operating-theater only 5 minutes. Liston's remark as the patient was leaving the theater was "This Yankee dodge, gentlemen, beats mesmerism hollow."

Lizars, who was appointed Professor of Surgery in the College of Surgeons of Edinburgh in 1831, is well known in America as being the first surgeon in Great Britain to perform the operation of ovariotomy, which had been introduced by your own countryman, MacDowell. MacDowell had sent a copy of his first paper to his old teacher, John Bell, of Edinburgh, who was then ending his days in Italy. The paper came into the hands of Lizars, who was also a pupil of Bell's.

Of all my predecessors, however, the immortal Lister stands out pre-eminent, and I refer to him with the deepest humility, as I am only too conscious of my inability to maintain the great traditions which he created in the Edinburgh School. The Very Rev. Dr. Wallace Williamson, dean of the Thistle, and minister of the historic Cathedral of St. Giles in Edinburgh, which most of you have no doubt visited, has contributed to the history of medicine a most beautiful and life-like piece of word-portraiture of Lister, and I rejoice to think that it will become immortalized by Garrison in his splendid work on the *History of Medicine*, a volume of immeasurable educational value and one which should occupy a foremost place in the library of every member of our profession. He says: "Of Joseph Lister's winsome personality, those speak most warmly who knew him best. It was his gentleness, above all, that made him great. His very presence was a spiritual force. Clear-eyed and pure of soul, he cherished from earliest days that love of truth which guided him to the end.

His noble passion for humanity extinguished all thoughts of self and personal fame, impelling him along that path which he steadfastly pursued till he found the greatest secret of his search, and bestowed on the world probably the greatest boon which science has been able to win for the physical life of mankind. Yet greater than his greatest achievement was the man himself, and the final secret of his greatness was that serene simplicity which was his most distinguished characteristic. His was the grave and thoughtful courtesy which bespoke the Christian gentleman and the earnest lover of his kind. Hence we are not surprised to learn how he stirred enthusiasm and moved men to reverence, how he gained such love and affection as rarely falls to a scientific teacher. Behind his acknowledged mastery of his science, his grave and noble face, marked by soft lines of tranquil thought, revealed a soul of singular beauty and sweetness, of high integrity and stainless honor. That such a man, dowered with God's gift of genius, should rise to the lofty heights and achieve great things was inevitable." [1]

Although the last century saw the end of the purely anatomical era of surgery, I have no hesitation in bringing into the foreground the prominent part which the great surgeon-anatomists of my school have taken in the evolution of surgery. The medical curriculum is now so overcrowded that the medical student, while he may be more spoon-fed with anatomical details, does not acquire the same dissecting-room knowledge of anatomy that was possessed by the student of my day. The dissecting-room is the surgeon-probationer's basic laboratory. My advice to all my house-surgeons who wish to take up surgery as their life-work is to go back to the dissecting-room and teach practical anatomy for at least one year. This is not only good for himself, for surgery, and for his patients, but it is an advantage also to the dissecting-room, as it supplies it with demonstrators who can appreciate and point out the bearing of anatomical details and topographical relations on the practice of surgery.

[1] Rev. Wallace Williamson. Brit. M. J., 1912, i, 444

It has been said that a weak point in the training of the young American surgeon of the present generation is his deficient knowledge of morbid anatomy and morbid histology, and that he too often feels the need of a pathologist at his elbow in the operating-theater. Personally, I am always grateful that early in my career I devoted time to the study of surgical pathology. For two years following my house-surgeonship I was a whole-time demonstrator of anatomy, and for the succeeding 9 years, during which I taught surgical anatomy, I had charge of the pathological laboratory in connection with the chair of systematic surgery then occupied by Professor Chiene. In this capacity it was my duty to give demonstrations in surgical pathology to his class and to examine and report upon all material derived from his wards. The surgeon of today cannot be regarded as fully trained unless he himself is pathologist enough to be able to assess the significance of the naked-eye and histological appearances of the tissues and organs with which he has to deal.

The last half-century has created a new epoch characterized by an ever closer alliance between the basic sciences of physics and chemistry with physiology and pathology, and the closer application of all of them to the practice of surgery. The chief pioneers of this new era were Kocher and Horsley, and for the present stage of its evolution we are indebted to the brilliant researches of such men as Cushing, Carrel, Crile, and to Plummer, Kendall, and Rosenow of the Mayo Clinic—in short, to the American School of Surgery.

The problem before surgeons today is: "How is this more scientific and enlightened conception of surgery to be encouraged and promoted?" The question is of the greatest importance from the academic point of view. In the first place we must not merely rearrange the time-table of the curriculum, but we must also reform and co-ordinate the teaching in such a manner that the student may be shown how to apply his knowledge of the basic sciences to the investigation and treatment of disease—in other words, to his clinical work.

In Edinburgh, in addition to the professorship of chemistry, we have a chair of chemistry in its relation to medicine, and the same applies to the teaching of physics to the medical students. With regard to botany and zoology, these subjects must of necessity be taught in the Faculty of Science as separate sciences. It is to be hoped, however, that in the near future, the medical student will be given a combined course of animal and vegetable biology, and that the syllabus will be drawn up on such broad and fundamental lines as to ensure that the course will provide him with the best possible foundation for his future studies. It is quite possible that the ideal professor for such a purpose does not exist, and that he will require to be created and specially trained for the purpose. It is a man of the type of the late Professor Huxley that is wanted.

It is to be hoped that the teaching of physics and chemistry in the secondary schools will soon reach such a high standard that these subjects may be relegated to the University entrance examination; otherwise the medical curriculum will have to be still further extended.

Edinburgh now as in years past holds the record for undergraduate medical education. While her machinery is specially constructed for this purpose, her 1,800 medical students seriously handicap her in providing facilities for postgraduate clinical work.

It is lack of funds which is sadly crippling us in respect of facilities for original research, and unless the money is forthcoming for the Institute we hope to erect as a memorial to Lister, and for which we are at present making an appeal, I am afraid Edinburgh will not be able to pull her full weight. The existing University laboratories are already heavily taxed with the work necessary to keep up the high standard of undergraduate teaching.

The constitution of the American College of Surgeons shows that the best surgeons of America intend to translate their ideals, their vast energies, their intellect and wisdom into terms of united action for the good both of the guild and of the community. The destiny of the College is in the hands of men who are known throughout the surgical world, men who have traveled and made themselves familiar with the organization of the ancient surgical corporations and surgical schools of Europe. Your College starts with a clean slate, unhampered by tradition. True, you have undertaken a gigantic task, such as only Americans would have the courage to venture upon, but when I read the names of the Governors and Regents, I am confident their efforts will be crowned with success. No one can sign the pledge of your College without a sense of responsibility being aroused within him. I feel sure, however, that every honest and conscientious surgeon must admit that, in signing it, he is pledging himself to do no more than is his duty to himself, to his profession, and to the community.

A point which especially arrested my attention on reading the by-laws was the emphasis placed on "interchange of opinion" and "attendance on the important societies and clinics." Surgeons of the individualistic type, who are contented with confining themselves to the knowledge gained by their own exclusive experience, can reach only a certain standard of efficiency, and, while it must be admitted that a few reach a high standard, it is safe to say they have done so in spite of their self-sufficiency and not because of it. That they would have ranked still higher in the surgical world had they been willing to learn from others, everyone will I think admit.

Perhaps the most striking clause in the laws of the College is the admission to your Fellowship without examination. This departure from precedent was not only justifiable, but, under the circumstances, necessary. Experienced examiners on my own side of the Atlantic have for long felt that the admission of candidates to our Fellowship by the methods of examination at present in vogue is open to serious criticism. It by no means follows that, because the candidate has passed the examination, he is competent to perform major operations. It is to be hoped that the bold, enlightened, and sagacious step which your College has taken will encourage our own colleges to take further and possibly similar precautions to see that

candidates who obtain the Edinburgh Fellowship are worthy of the distinction. Whether your College obtains sufficient evidence that your successful candidate possesses an adequate knowledge of anatomy and pathology is the only criticism I would venture with regard to your present system.

The first impression one might gain after reading the Constitution and By-laws of the American College of Surgeons is that they have been framed in such a way that the governing body is vested with an authority and disciplinary powers which might be said to interfere somewhat with the liberty of the subject. Even if we admit a certain amount of truth in this impression, it must be remembered that the profession has a duty both individually and collectively, not only to its own members but also to the community which it serves. It may safely be asserted that in no walk of life, in no other profession, and in no other branch of our profession is the life of the subject so much at the mercy of his fellow-man as when he places himself in the hands of the surgeon. It is only right and proper, therefore, that the profession itself should see to it that such a sacred trust, and such a powerful weapon for good or evil, should be placed in the hands of men who have shown that they are morally as well as intellectually and technically capable of fulfilling the trust. In America, these powers have been vested in a Council of Regents and an Executive consisting of men of the highest integrity, of great experience, and of powerful intellect—men who combine great foresight and sagacity with sound judgment, men who can think as able administrators as well as function as great surgeons. Such combined effort is calculated to secure a fine and accurate adjustment of the activities and functions of the surgical profession.

It was the War—a war of science—which brought very forcibly before us what may be accomplished by properly combined and co-ordinated effort fortified by authority and discipline. The peace which has followed has created the opportunity and the necessity for breaking away from tradition, for readjustment, and for reconstruction. The phenomenal progress which surgery has made during the present generation and the added knowledge gained through the War has made it all the more imperative that surgery should set its house in order. The surgical world is grateful to America that she has taken the initiative in combining and co-ordinating her surgical forces with the object of raising the general standard of surgery not only in its academic centers but in the hospitals throughout the States. What is needed is co-operative thought transformed into co-operative action. These basic aims have evidently been in the minds of those who drew up the constitution and by-laws of your College. By vesting the general management of your corporation in a Board of fifty Governors who shall select fifteen of their number, along with the President for the year, to form a Board of Regents in whom shall be vested the details of management, and by choosing from the Board of Regents an Executive Committee consisting of the President, the Secretary, the Treasurer, and five other Regents, the College has created a powerful "thought-organization" capable of originating and carrying out an enlightened and far-reaching policy.

The molding and developing of hospitals, their better equipment, and the improvement of the standard of work done in them are some of the most important pieces of organization and propaganda work that your College could undertake. By placing your expert knowledge and experience at the service of the American Hospital Association, you secure a unity of thought and purpose which cannot fail to have great influence upon public opinion and ensure the co-operation and sympathy of the municipal authorities as well as open the purse-strings of the well-to-do citizens. It is important that the lay public be made to see that, after all, the hospital is the surgeon's schoolroom, and, the better it is equipped, the better will be the training of the surgeon and the better the treatment of the citizen.

The systems of hospital organization in Great Britain and America differ very materially. In my own country, all the large teaching hospitals—indeed, the large hospitals generally—are supported almost entirely

by voluntary contributions, so that each hospital has its own organization and method of administration. There is no attempt at combined effort with a view to standardization, and little has been done to encourage architects to specialize in hospital construction or to create a body of expert hospital superintendents.

Our own hospital system has recently been the subject of a Parlimentary inquiry. The Committee has reported in favor of a continuance of the voluntary system, but it is doubtful how long this system will survive under the present burden of taxation. The municipal authorities will certainly be against the placing of our large hospitals on the rates. While our hospital system is excellent from the point of view of the working classes, it does not meet the requirements of the middle-class population in the way that your system here does. The American system, however, may I venture to suggest, has two defects which I feel sure the American College of Surgeons will be able to remedy without calling in the aid of the State, or I should say without the interference of the State. I refer, firstly, to the rotation system of a three or four months' service of general practitioners on the staff of the surgical side of hospitals; and, secondly, to the system whereby facilities are given to practitioners of little or no surgical experience, for operating on their private patients in public or semi-public hospitals. These two customs may in great measure be responsible not only for the relatively large amount of surgery done by general practitioners in America but also for a tendency to the commercialization of surgery.

In my own country, we are inclined to go to the other extreme. The want of proper hospital accommodation for our middle classes sometimes compels us to operate on patients in their own homes or in imperfectly equipped nursing institutions. While it may occasionally be necessary for a good surgeon to operate under unfavorable conditions, his conscience ought to dictate that he should only give the patient his second-best when it is impossible to do otherwise.

Specialization in surgery should not be discouraged provided it is preceded by a good general training in surgery. It encourages intensive work in those with special aptitudes: the work itself is better done, and an added zest for it is created. A fine adjustment of task to individual aptitude is an economy of effort and applies not only to modern surgery but to modern education generally.

I think I am correct in stating that it is just forty years since the Harvard Medical School instituted a Department of Orthopedic Surgery, and I am sure my American confrères will be surprised to hear that no such department exists in the Edinburgh Royal Infirmary. Thanks to the genius and magnetic influence of Sir Robert Jones, assisted by a band of orthopedic experts from America, this branch of surgery did outstanding work during the War, indeed, it furnished perhaps the best illustration of what may be achieved by able generalship, good organization, and team-work.

It is to be hoped that the lesson to be learned from the orthopedic experience and achievements during the War will bear fruit, and that, by the establishment and proper equipment of an orthopedic department in our teaching centers, the standard of the surgery of the extremities will rapidly improve. We envy America her public-spirited citizens who subscribe with such open-handed generosity to every kind of educational institution. The Edinburgh Royal Infirmary, with its 900 beds, is an imperial institution from the point of view of medical education. It draws its patients not only from Edinburgh and district but also from a large part of Scotland as well as from the north of England. The Board of Management has recently issued an appeal for £250,000 without which it will be impossible for it to maintain its traditionally prominent place in the advancement and teaching of medical sciences. So far, the appeal has brought in only about £40,000. Unfortunately, Scotland is a small and relatively poor country, with no millionaires, and I am sorry to say the chairman of the finance committee, who is fully alive to the necessity of establishing an orthopedic department in our great hospital, tells me that it cannot be done—unless some Scots-

man who has amassed wealth overseas can be persuaded to come to the rescue.

Already America has done splendid work in establishing a proper system of preserving and cataloguing case-records. It is only in this way that a reliable analysis and review of the immediate and remote results of operations can from time to time be obtained. If the College of Surgeons can help to establish a definite and more standardized follow-up system, such as exists in Boston, Rochester, Baltimore, Cleveland, and elsewhere, statistics of real value will be obtained.

Your College affords great possibilities also in the way of assessing the real value of various methods of treatment which are at present in a more or less experimental stage. Think, for example, of the benefit which would accrue from a well organized collective investigation into the value of radium and X-rays in the treatment of malignant disease. With the machinery for organization which your College possesses, the untold wealth of material at its disposal, and the reliable observations which could be guaranteed, I am convinced that in this line of investigation, America could head the world.

Surgery and science generally are ever becoming more and more international. America has taken more advantage of this cosmopolitan spirit than we Britishers, and in my judgment, this is the main reason why the scepter of surgery is today wielded by America.

British surgeons, I feel confident, rejoice that you have taken Canada into partnership with you in founding your College. The next step, I trust, will be a closer alliance with British surgery. I am thankful to say that at last we have formed an Association of Surgeons of Great Britain and Ireland, having the same ideals and aims as the American Surgical Association, and it is to be hoped that these two bodies will form the beginning of an intimate English-speaking surgical brotherhood. Science, and especially medical science, recognizes no frontiers: it is the most powerful agent we possess for welding together our two nations—a union which would go far to ensure the peace, the happiness, and the prosperity of the world.

I cannot do better than conclude with the words used by Sir Berkeley Moynihan, an Honorary Fellow of your College, who, as you all know, is as well as a great surgeon an inspiring writer: In presenting you with the mace I see before me, he said, "We pray God may regard it as a symbol of our union in the harsh days of trial, as a pledge of unfaltering and unchanging hope that the members of our profession in the two lands shall be joined in brotherhood forever in the service of mankind."

# OLD METHODS VERSUS NEW IN SURGICAL DIAGNOSIS[1]

By JOHN B. DEAVER, M.D., F.A.C.S., Philadelphia

IT is with a deep sense of privilege coupled with no less a sense of obligation that I assume the high office to which you have been pleased to elect me. Not the least of its privileges is that of extending a word of welcome and greeting to our colleagues from far and near who have come to grace these meetings with their presence, and to extend the hand of fellowship to those chosen to be received in our ranks. Not the least of its obligations is that of maintaining the high standards set by my distinguished predecessors in office. With your co-operation and encouragement, I hope I may wear the mantle of office which has just fallen upon my shoulders as gracefully and as effectively as they have done.

High standard in surgery is the primary reason for the existence of this organization. In formulating these standards, it is well to bear in mind that the new is not always the best, nor is youth always wiser than age. Huxley has well said that none of us, not even the youngest among us, is infallible. Men of experience have seen method after method heralded as a panacea, lauded to the skies, only to fall in disuse and be consigned to a well deserved oblivion, because it has failed to stand the acid test of experience. I hesitate to express my fear that this may prove to be the ultimate fate of radium treatment for cancer; for I should greatly regret to see our fervent hopes rudely shattered. But at least I feel justified in sounding a note of warning against too great expectations, for we have already found that it falls far short of being a universal cure and, indeed, in many situations where we most need help, it has proved sadly lacking. In the progress and development of medicine there have arisen allied branches both in medicine and in surgery, too numerous for any one man to dare hope to make his own. The result is the specialist in practical and in theoretical work. And even the specialties are divided and subdivided into almost numberless branches. So that in the last half century or more there has been a great transformation in surgical and medical practice. These sister sciences, while they have added to the joys of practice have also increased the responsibilities of the profession.

If the impression of one who has seen the new order displacing the old is worth consideration, if observation of methods formerly relied upon as contrasted with those now particularly stressed may call forth reflection as to their utility in the actual hand to hand combat with disease and death, I may perhaps be permitted to say that in this process of transformation there seems to lie a danger of underestimating the value of the old and tried methods of clinical diagnosis by sight, touch, and hearing, and of regarding these as less scientific than something that is gained through the medium of a piece of apparatus, or by a reaction in a test tube. The exactness of a scientific method does not mean that its results may be applied to diagnosis, prognosis, or treatment with the same mathematical accuracy. The deductions from such a method may be hazardous in the extreme if applied to clinical purposes. As an example of such an error we may mention the attempt to base the indication for operation in appendicitis upon a rising leucocyte count. This was gross clinical ignorance, and ignorance can never be scientific. All data, however, must be submitted to interpretation before judgment can emerge, and data gained directly by questioning and by the older methods of examination have exactly the same scientific status as those secured by indirect methods. Moreover, up to the present time their value greatly predominates in assessing the individual case and conditions. We must see to it therefore that while the boundaries of knowledge are being extended and while we are placing new tools in the hands of the younger generation, the older arts which are the chief reliance of the diagnostician must receive proper emphasis.

With the advent of each new decade in the dramatic progress of surgery within the last

[1] President's address Clinical Congress of American College of Surgeons, Philadelphia, October 24, 1921.

half or three-quarters of a century it seemed as though the limits of improvement in diagnostic and operative procedure had been reached. But no sooner was one new avenue of endeavor opened than the pathway became ever wider and wider. No sooner did we have the boon of general anæsthesia than we were enriched with the means of producing local anæsthesia, which has become an indispensable part of every operating theater. Hardly were we in possession of Pasteur's and Lister's epoch-making discoveries than we found ourselves in the midst of the new science of bacteriology and its sister branches, and of surgical pathology studied on the living subject. And then came the era of active experimental research, which with rapid strides has added so much to our knowledge of certain phenomena. With the advent of the world war came the opportunity of applying to large numbers of cases the numerous theories developed during the years of patient work in the research laboratories of chemistry, physiology, and pathology, while the exigencies of the hour brought forth brilliant measures which made it seem as though our surgeons had, indeed, been endowed with the wand of magic. The varied program offered for our meetings during the coming week, holds out the prospect of having in store much valuable information on the very interesting results of war surgery. Indeed, a glance at the diverse subjects to be handled and demonstrated would justify the assumption that finality in surgery had at last been reached, for there is now practically no region of the human body that is closed to the aseptic scalpel of the surgeon. I think, however, I may venture to say that we who are daily at work at the operating table and in the sick room, know full well the limitations of our science and our practice and the lack of finality in the art in which we, "looking for the high white star of Truth," aspire to become masters, and the mastery of which today is beset with much greater difficulty than at any former time.

The future of surgery and of surgical research doubtless belongs to America, and on the American College of Surgeons rests the responsibility of fulfilling the promise which that future holds out.

In conclusion, I can only hope that the work of the present Congress will be fruitful of results and that when it comes to a close there will have been something permanent added to our knowledge and that we will have gained renewed courage and inspiration to carry on for our common purpose: To bring healing to the nations and promote the welfare of mankind.

# MASSIVE HYPERTROPHY OF THE BREAST[1]

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## INTRODUCTION

ANOMALIES of the breast have always attracted a peculiar interest, every degree and type of developmental error having been described in both male and female. Possibly because of their relative frequency or because they might offer some clue to the reason for normal physiological development, hypertrophic disorders of the mammary gland have been studied more closely than other pathological conditions of this type.

A certain degree of excessive enlargement of the breast is within physiological limits, as for example, the prominent breasts seen not infrequently in young matrons and much oftener in parous women after the menopause. Such hypertrophies can hardly be considered pathological and are usually concomitant features with an obese habitus. Rarely, however, the bounds of physiological development are broken and the breasts attain such proportions as to become a nuisance to their possessor, either because of their unsightly appearance or because of the encumbrance imposed by the mere burden of their weight. In extreme cases life itself may become impossible unless surgical intervention is undertaken.

Writers who have mentioned such cases have often left some doubt with regard to the true pathology of the condition. Their meager descriptions might apply equally to large tumors or to true mammary hypertrophy. Hence little reliance can be placed on earlier medical literature. Probably the first case of established authenticity is that described by Durston in 1669. This case presents remarkable features. It is claimed that the entire process of hypertrophy took place within the space of one night. The weight of the left breast was 64 pounds, that of the right 40 pounds, a total weight of 104 pounds, so far as I know, the greatest on record. It is probable, however, that either the patient or the physician may have been mistaken with regard to the time of development.

Labarraque, in 1875, was the first to consider the subject of mammary hypertrophy in a scientific manner. Five years later Billroth reported several cases and made some important observations on the pathology of the condition, giving it the name "diffuse true mammary hypertrophy." Kirchheim, in 1902, collected 31 cases, reported in detail a case of his own, and discussed the possible etiological factors. Johnston, in 1903, reported a case, and gave an excellent pathological description of the amputated breasts by Bloodgood. Guthrie and Albert, in 1916, reported several cases of which excellent pathological studies had been made. Deaver and MacFarland, in their remarkable monograph on the breast, tabulated the chief features of 240 cases which they collected from all sources, some being of admitted questionable authenticity.

## FACTORS AFFECTING MAMMARY DEVELOPMENT AND FUNCTION

In a study of excessive mammary hypertrophy, it may be of value to consider briefly a few of the main facts concerning normal mammary development and function, and some of the more tenable hypotheses that have been advanced in explanation.

The mammary gland seems to be a modified group of sudoriparous glands (Keibel and Mall). On the ventral surface of the 9 millimeter embryo is a thickening of the epidermal cells, known as the "milk ridge." From this ridge, by downward growth of epithelial columns, which form at first papillary and later bulb-shaped anlagen, the breast develops. Secondary bud-like extrusions of the epithelium from the terminal portions of the bulbs, piling up of the corium cells to form a nipple, and absence of development of hair follicles in the pigmented areolar zone serve

[1] This work was done in the Section on Surgical Pathology, Mayo Clinic.

to complete the picture of the embryonic mamma. At birth the gland consists of a nipple on whose surface from fifteen to twenty lactiferous ducts empty, each corresponding to a column of epithelial cells which has been slightly hollowed out by a central process of cornification. These columns divide dichotomously, and from the terminal radicles bulb-like extrusions, the primitive acini, arise.

Shortly after birth in both sexes, there are signs of mammary activity. This is associated with phenomena such as swelling, redness, and the secretion of so-called "witches milk." When this period of activity is over it is found that the epithelial columns are no longer solid but have become tubular throughout. Hence it is possible that the symptoms associated with these changes may be due to the expression of the central core of cornified epithelium in the mammary columns. The female breast shows, at this time, its first evidence of differentiation from that of the male; the number of branchings of the tubules and the total amount of parenchyma in the former are markedly increased.

From infancy to puberty the breast undergoes few changes; the tubules, however, become gradually more numerous, especially in females. The attainment of sexual maturity brings changes in both sexes but these are of greater magnitude in the female. There is an increase in the size and number of the parenchyma cells, more frequent branching of the tubules, and a corresponding increase in the amount of adipose tissue which definitely divides the parenchyma into lobes. Occasionally secretory activities are apparent, but this is somewhat unusual. The changes which occur in the male breast are relatively insignificant so that at maturity a few tubular elements with a slight amount of subcutaneous fat comprise the entire male mamma. Rarely the male breast may simulate the female breast in type of development, giving rise to a condition known as "gynecomastia." This process is frequently associated with other sex anomalies and is rarely excessive; this is hardly within the scope of the subject under discussion. Gravidity and lactation again bring further increase in the size and probably in the number of epithelial cells. Pocket-like alveolar outgrowths from the branching tubules become dilated, thus giving rise to true mammary acini. There is a relative diminution of the adipose tissue at this time. The acini appear to be lined with a single layer of columnar cells and it is difficult to distinguish the membrana propria as a separate entity. During lactation the acini and its lining cells become distended with an albuminous fatty fluid, the milk.

The factors which control the development and functioning of the breast are almost certainly of the order of hormones and are in close relationship to the organs of reproduction. The older theories of a nervous control have been forever put aside by the conclusive nerve sectioning experiments of Goltz and Ewald and of Pfister and Eckhard, as well as by the even more significant mammary transplantations of Ribbert. From the clinical standpoint it is found that normal puberty hypertrophy and ovulation begin at approximately the same period; that cretinism and hypopituitarism, especially that of the Froehlich type, are likely to be associated with mammary hypoplasia; that hyposexual development (such as infantile uteri, and small ovaries) are likely to be associated with undeveloped breasts, that precocious sexual maturity will probably be accompanied by early puberty hypertrophy, and finally that after the establishment of the menses signs of mammary activity may develop at each catamenia, fullness, swelling, tension, sometimes pain, and rarely secretion having been observed. A great deal of experimental work has been accomplished but it may be said that this has served to confuse as much as to clarify the problem. Castration of young animals before puberty prevents normal mammary development, which, however, may be brought about after such an operation by a transplantation of one of the removed ovaries. Hammond and Marshall have demonstrated, experimentally, that hysterectomy alone, the ovaries being retained, has no influence in preventing puberty hypertrophy. This would seem to rule out the uterus from consideration. Loeb and Hesselberg claim to have established the fact that there is a definite cycle of mammary activity in guinea pigs

which runs parallel in some degree at least with that of heat and ovulation. They believe, further, that they have shown the corpus luteum to be a prominent if not the chief factor in both puberty and pregnancy hypertrophy. The causes which bring about the changes of the breast in gravidity and lactation are even more obscure. The decidua (Loeb and Hesselberg), the fœtus (Lane-Claypon and Starling), the placenta (Halban, Basch), and the corpus luteum (Ancel and Bouin, Loeb and Hesselberg), have all been given the chief rôle as mammary activator, but the experimental evidence is conflicting and inconclusive, as Frank and Unger have emphasized. Clinically it is known that the corpus luteum is excessively enlarged during pregnancy and that there is often a disturbance of lactation on the return of the menses; both of these features point to an ovarian control of mammary activity. In contradistinction to this is the fact that castration after pregnancy begins does not prevent but rather prolongs lactation. The hypothesis might also be advanced that the return of ovulation tends to bring about a return of the breast to its former resting condition and that an absence of this stimulus is associated with a delay in this regressive process. The degree of mammary hypertrophy during lactation seems to be in no way related to the total amount of milk secreted. Another clinical feature of note is that at the menopause cessation of ovulation and menstruation is accompanied by atrophic changes in the parenchyma of the breast and also as a rule by an increase in the fatty tissue. Finally it has been established that pituitary (posterior lobe) extract acts as an efficient galactogogue during the period of lactation but whether this is a direct or an indirect influence is not clear.

Although knowledge of the physiology of the function of the mammary gland is incomplete and problematic, nevertheless facts as follows are presented as being approximately correct:

1. The mammary gland is under the control of endocrine forces.

2. The occasional instances in which psychical factors seem to play a part, illustrated by the unusual cases of elderly women or young children who have been known to lactate on having an infant placed at the breast, may be explained theoretically by indirect influence on the internal secretory system.

3. Puberty hypertrophy is almost certainly dependent on ovarian activity.

4. There is a definite cycle of mammary activity running somewhat parallel to the menstrual cycle.

5. There is suggestive evidence that the corpus luteum by its formation, persistence, or regression may influence the normal cycle of activity of the breast in pregnant as well as nonpregnant states.

6. No good evidence has been adduced that the uterus, decidua, fœtus, or placenta have any direct bearing on the function of the breast.

## CLINICAL FEATURES OF MASSIVE HYPERTROPHY OF THE BREAST, REVIEW OF CASE REPORTS

In attempting to show the manner in which massive mammary hypertrophy deviates from normal physiological development, a review of the clinical information to be gained from case reports is of value. The usual patient is one who shortly before or after the first catamenia begins to notice an enlargement of her breasts. At first this may attract little attention and is thought to be the physiological development normal to this time of life. Soon, however, the excessive increase in size becomes a matter of concern and a source of great embarrassment to the patient and to her family. The course of the process from this time on is variable. There may be no further enlargement, or the breasts may progressively increase in size, reach even to the knee and weigh as much as 60 pounds. All intermediate degrees of hypertrophy have been reported.

*Age.* The age at onset in one-half of the bilateral cases was under 18. The greater number of patients come under observation at 16 years. The youngest patient mentioned was 12, the duration of the growth having been one year (Firket). The oldest patient was 48, the duration having been 16 years (Ehrenhaus). In 120 cases in which the age at onset is given, or can be inferred with

approximate correctness, the following is found:

Twenty-eight patients were under 15 years of age.

Fifty-nine patients were from 15 to 20 years. Fifty-four were virgins; three were pregnant; details were not mentioned in two.

Twenty-four patients were from 20 to 30 years; nine were pregnant or parous; six had not been pregnant; details were not given in nine.

Eight patients were from 30 to 40 years; three were pregnant or parous; details were not mentioned in five.

One patient was between 40 and 50 years. No details were given.

*Race and climate.* Racial and climatic factors apparently have no bearing on the etiology. American, English, French, German, Italian, Chinese, Negro, Hindu, and other races are mentioned.

*Heredity.* Heredity is mentioned as a possible factor in three instances. Pflanz reported the case of a married woman, aged 30, whose mother had suffered at one time with great enlargement of the breasts and whose brother was gynecomastic. Englander reports a case of an adult woman with enlarged breasts, whose mother had had a right breast twice the size of the left. Caubet reports the case of a girl 12½ years, with massive hypertrophy of the breast. Her mother had had the same condition at the same age, but subsequently the breasts had returned to normal size. The daughter, however, required an operation to relieve her of the cachexia which threatened her life. These cases indicate that heredity may be a factor, but not often enough to be of much value etiologically.

*The side affected.* The side affected is mentioned in 182 cases: the process was bilateral in 142 and unilateral in 40. In twenty-five of the unilateral cases, the left breast was involved seventeen times, the right eight times.

*Duration of the process.* The duration of the process is extremely variable. Aside from Durston's improbable report, the shortest period of massive growth is in Zurakow's patient, a pregnant woman of 22 whose breasts attained large proportions in the short space of 2½ months. The average duration of growth in young pregnant women has been about 10 months. The average period for all patients under 21, virgin, married, or pregnant, is 20 months, while the average for all patients over 21 is 5 years. The shortest period of growth in patients under 21 is 2 months, while the longest period is 4 years. In women over 21 the shortest period is 2½ months and the longest 16 years.

*Size.* The largest breasts recorded are those of Durston's patient (heretofore recorded). Porter's case with a left breast of 43 pounds and a right breast of 17 pounds is probably the next. The majority of the patients had breasts of from 7 to 10 pounds. As the border between physiological and pathological hypertrophy is not easily defined, no sharp line of demarcation between the two can be drawn.

*Secretory activity.* The secretory activity of the mammary gland in massive hypertrophy is extremely variable. There is no relation between the degree of hypertrophy and the amount of secretion. Freund had a patient with a tremendous pregnancy hypertrophy who failed to lactate, while Zurakoff and Benoit and Monteils report instances in which lactation was absent in parous women whose hypertrophy had taken place before they became pregnant. On the other hand cases in which lactation followed the massive hypertrophy of pregnancy are cited by Anthony and Warren, Esterle, Gibson, Ramsbotham, Rosinski, Speth, and Van Swieten. Ehrenhaus had an unusual case of hypertrophy in a non-pregnant multipara, who secreted as much as a quart of milk a day. In the cases seen in the Mayo Clinic abnormal secretory activity has not been observed. However, it should be noted that in Case 3 the patient had nursed her child after the onset of the hypertrophy which began with pregnancy.

*Pain.* Pain of varying degree was present in about nineteen cases. True pain is not to be confused with the discomfort and fatigue so frequently brought about by the ponderous mass of the breasts alone. In our four cases pain was a prominent feature; from the beginning in Case 4. It was entirely absent in Cases 1 and 3, and was insignificant in Case 2.

*Clinical course of growth, influence of menses, pregnancy, lactation, spontaneous regression.* The rate of growth of the enlarging breasts varies markedly. It may progress uniformly or intermittently. The relation of the hypertrophic process to menstruation, pregnancy, and lactation, conditions under which ovarian activity undoubtedly reaches a high degree, may be noted. The hypertrophy frequently commences immediately before or after the establishment of menstruation. In the case of Schoal the patient never menstruated, while in our Case 2 menstruation was always meager and ceased entirely after the breasts were amputated. Sometimes menstruation seems to act as a stimulus to growth. Thus Ferrus reports the case of a Spanish girl whose breasts progressively enlarged with each successive period. On the other hand the establishment of a normal menstrual cycle may be associated with a diminution in size of the hypertrophic breasts and possibly with a return to normal (Lane, Benoit and Monteils). Pregnancy and lactation likewise have an inconstant influence. Thus the breasts may become greatly enlarged during successive pregnancies, to diminish in size after lactation (Speth, Van Swieten, Monod, Anthony and Warren, and Cerutti). Freund's remarkable patient with an enormous gravidity hypertrophy failed to lactate, but on the fourteenth day of her puerperium both breasts began markedly to diminish in size. Jorden, Esterle, and Ramsbotham cite further instances in which excessive hypertrophy during pregnancy was followed by a return to normal after lactation. Ramsbotham's case was that of unilateral hypertrophy.

Spontaneous diminution in size unassociated with pregnancy is also known to occur. Hey, Hoy, Schield, Le Double, and Terrill report cases in which the removal of one breast was followed after a variable length of time by diminution in the other. Labarraque, Shield, Zurakow, and Velpeau had patients who noticeably improved under treatment by compression and iodides given internally, while Delfiz reported one case which he cured with inunctions of mercury hydroiodate. Thompson had a patient whose breasts had returned to normal size 3 years after she first came under observation. Billroth had a similar case. Kirchheim, in his case of virginal hypertrophy, tried a partial resection with a plastic operation on one side, but the unresected portion of the one breast and the entire gland on the other side continued to grow to such an extent that total bilateral ablation had to be performed.

Thus it is seen what a variable and uncertain course this pathological process may take. Forces which stimulate growth in some cases have just the opposite effect in others and cause the appearance of regressive changes.

*Association with sex anomalies and pathological conditions of the reproductive organs.* Several authors have mentioned the occurrence of sexual anomalies or disease of the reproductive organs in association with massive hypertrophies, such as patients suffering from scanty menses or total absence of the menstrual function. Our Case 2 is an example. Foges, Warren, and Herczel had patients with massive hypertrophy and supernumerary mammæ, which were also affected by this process of overgrowth. Bryant's patient had a bifid uterus and other sexual abnormalities. Bartel's patient had an infantile uterus, and very small ovaries; Kirchheim's patient presented much the same features, the ovaries being extremely painful. Grah's patient, aged 14, suffered from ovarian disease. Week operated on a woman of 42 for uterine disease. Her breasts, which had been greatly hypertrophied, immediately began to diminish in size. From these instances it appears that the association of massive hyertrophy with some form of abnormal condition in the genital organs is not infrequent and in taking the history of each case a searching inquiry should be made with this association in mind.

### CLASSIFICATION OF MASSIVE HYPERTROPHIES OF THE BREAST: PATHOLOGICAL CONDITION

There should be a sharp distinction between true mammary hypertrophy and those excessive enlargements which are due to the presence of tumors, such as intracanalicular myxoma or fibroma, lipoma, sarcoma, and so forth. Pathological hypertrophy is a condition in which the normally differentiated tissue ele-

ments of the glands singly or severally undergo enlargement and hyperplasia which is diffuse throughout the entire organ. Thus Durston, speaking of the breasts in his patient, said that nothing was found but "prodigious bigness." However, there are slight variations in type of tissue of overgrowth which call for a grouping of these cases in certain general classes. The tendency has been to classify such enlargements by some name which designates the time of life or the conditions under which they have occurred. Thus the names "infantile hypertrophy," "diffuse virginal hypertrophy," "gravidity hypertrophy," and "hypertrophy in parous women unassociated with pregnancy" give the necessary implication.

Most of the pathological reports have been consistent in certain features: Flattening of the nipple is almost always present and may account for the frequent interference with secretory activity in the puerperium as the infant is likely to find difficulty in suckling. Thickening of the skin, hypertrophy, fibrosis, diffuse fibro-epithelial tumor associated with fibro-adenomata are also prominent terms in the usual description. Porter described the condition in his case as diffuse intracanalicular fibro-adenoma. Adiposity is rare; only four cases have been described. When present it seems to be diffuse and is usually the predominant tissue element, as in our Cases 2 and 4. Malignancy in these breasts is certainly unusual, although Billroth reports a patient who developed a sarcoma, and Bloodgood mentions the occurrence of carcinoma and of sarcoma under such circumstances. Kirchheim describes the breasts in his case as consisting of hypertrophied glandular and fibrous elements through which fatty tissue was distributed in intimate relationship to the parenchyma. Bloodgood's report of the pathological condition in Johnston's cases mentions hypertrophied skin, fibrous hyperplasia with a moderate diffuse epithelial proliferation, encapsulated fibro-adenomata, atrophy of the subcutaneous fat, and general sparseness of fat elsewhere, as the predominant features. Some of his photomicrographs seem to show the activity of the tissue reserve cells (textoblasts) of the outer layer of the acinar epithelium, a process which has been found prominent in the cases in the Mayo Clinic. The interstices of the fibrous tissue were filled with a serum-like fluid in our Case 1. Succulence of the fibrous tissue has been frequently mentioned in other cases and was present to a moderate degree in this case.

A review of the cases described in the literature, and of the four cases in the Mayo Clinic has led to the conclusion that from the standpoint of pathological physiology, massive hypertrophies of the breast are probably all different manifestations of an anomalous endocrine process and that a classification based on the time of life or the parous state is likely to be misleading. Case 1 which is of the diffuse virginal type, and Case 3, which is a typical gravidity hypertrophy of long duration, present essentially the same histological pictures. Likewise Case 2, a virgin patient, and Case 4, a parous patient with the hypertrophy unassociated with pregnancy, have breasts which would be difficult to distinguish grossly or microscopically. Pathologically these cases may be classified in two groups, fibro-epithelial hypertrophy, frequently associated with fibro-adenoma, and adipose hypertrophy, in which fatty tissue composes the bulk of the massive breast. The latter condition is extremely rare according to Guthrie and Albert, who were able to find only three cases besides their own; these were the cases of Robert and Ammesat, of Warren, and of Beatson. My own study of the literature has failed to bring further evidence of the occurrence of the massive adipose hypertrophy, so that our Cases 2 and 4 are probably the fifth and sixth to go on record. However, it is likely that in certain cases both the fatty and fibrous tissues may be hypertrophied. For instance, Kirchheim states that in the breasts of his patient were islands of fat in intimate relationship to the parenchyma with which they were surrounded. But even here he remarks on the general diminution of fatty tissue in the breasts, and a general tendency for either the fibro-epithelial tissue, or the fatty tissue to be excessive, the former far more frequently than the latter. In either type of hypertrophy the presence of gravidity

or lactation may or may not superimpose the histological picture normally associated with that period.

The pathological data in the cases in the Mayo Clinic are given in detail in the histories of the cases. Summaries of the important features are as follows: In Case 1 a fibro-epithelial type of hypertrophy is associated with multiple fibro-adenomata and small retention cysts. Absence of fat, succulence of the preponderant fibrous tissue, regenerative changes in the acinar epithelium (primary cytoplasia of MacCarty), and rapid proliferative changes in the fibrous tissue of the adenomata are found. Case 3 is almost identical. It is a fibro-epithelial type which began with pregnancy. There is a tendency to a grouping of the acini into lobules, and the breaking up of these lobules by the invasion of differentiating, and differentiated fibrous tissue can be traced through different stages, as if the fibrous tissue had grown to such an extent as to choke the acini and bring about their obliteration. Cases 2 and 4 are of the adipose type. The patient in the former was a girl of 19, and in the latter a woman of 42, whose breasts had hypertrophied 12 years after a pregnancy. The grouping of the acini is broken up and fat is the preponderant element, the meager fibrous tissue being disposed of in radiating bands which carry a moderate number of acini whose basal layer of tissue reserve cells (textoblasts) shows signs of slight reproductive activity. The epithelial cells in all of the cases are hypertrophied to a variable degree.

### CONSIDERATION OF POSSIBLE ETIOLOGICAL FACTORS

Trauma was mentioned in the case of Velpeau but was not considered to have any bearing on the etiology. While the greatest number of cases occur about the time of puberty and adolescence, there are so many exceptions to this rule as to make it certain that this time of life is not essential to the development of the condition. The histological picture in no way suggests a true neoplasm, as the process is diffuse and seems to affect all portions of an entire organ simultaneously and uniformly.

It would seem more probable that massive hypertrophy depends for its cause on some dyscrasia of the endocrine system. Our knowledge from clinical and experimental sources leaves little doubt but that the normal growth of the breast is related to the sex organs, and is strongly suggestive that the ovary is the controlling factor in mammary development. Massive hypertrophy occurs for the most part in association with puberty and pregnancy, when the equilibrium of the internal secretory organs is probably temporarily upset to be re-established on a different basis. Under such circumstances it is possible that certain endocrine forces which stimulate the growth of fibrous and epithelial tissue may come into play, or more rarely adipose tissue. The fibro-epithelial type suggests in histology an overactivity of some endocrine organ while the adipose type might well be related to a hypofunction of the ovary, thyroid, pituitary, or adrenal cortex, singly or combined. Thus the association of the fatty breasts with menstrual irregularities in Case 2 and similar cases mentioned by Guthrie and Albert, suggest an abnormality of ovarian or pituitary type, although other features often associated with dyscrasias of these organs are lacking.

Against the theory of an endocrine etiology must be cited the rare cases of unilateral hypertrophy. These are indeed difficult to explain but the weight of their evidence is counterbalanced by the instances mentioned in which in addition to the hypertrophy of the true breasts there was a simultaneous massive enlargement of supernumerary glands. In short it may be said that in the light of clinical and experimental evidence there are strong reasons for believing that a dysovarianism is the probable cause of this anomaly. However, further development of the physiology and chemistry of the body hormones must be awaited before this point can be considered settled.

### DIAGNOSIS

As a rule the diagnosis offers little difficulty. Intracanalicular myxoma and fibroma, lipoma, sarcoma, elephantiasis, and the fatty breasts of general obesity are to be differentiated. The diffuse nature of the process, the

bilateral enormous enlargement, the uniformity of the growth, which is usually relatively rapid, the absence of pain, and the frequent association with puberty and pregnancy are, in the majority of cases, sufficient to make the diagnosis clear. The distinction between the adipose type and the fibro-epithelial type may be difficult. The former occurs much less frequently than the latter, and the breasts are, as a rule, soft, in the adipose type, while the fibro-epithelial overgrowth is usually associated with an increase in the firmness of the gland. This feature may be further accentuated in certain localized areas by the presence of fibro-adenomata. Elephantiasis occurs rarely, the few cases on record having been reported chiefly from Samoan and Russian sources (Deaver and MacFarland). It seems to occur for the most part in young women and may simulate very closely fibro-epithelial hypertrophy. Other features of elephantiasis may assist in the differentiation. In any event there is no practical loss since the treatment of the two processes is essentially the same.

### TREATMENT

The tendency of the breasts to undergo spontaneous regression in some cases leaves doubt with regard to the efficacy of various methods of treatment which have been employed on empiric grounds. Iodides, administered as inunctions and internally, local pressure, and various "applications" have been tried, but the number of cases in which they are claimed to have been successful modes of treatment is too small to allow definite conclusions. A conservative and practical plan is to wait for a length of time consistent with the health and mental composure of the patient in the hope that the enlarged breasts will decrease in size. If time fails to ameliorate the condition and the patient is desirous of being rid of her affliction, which is often as much mental as physical, then amputation seems to be indicated. While the operation deprives the patient of her mammary function it is hardly to be considered mutilating and has no evil sequelæ. Opotherapy, on the basis of an endocrine etiology, while theoretically possible, is neither rational nor feasible at the present time, although it is to be hoped that the future development of this field of medicine will lead to a new and more satisfactory method of treating this rare but most unpleasant condition.

### REPORTS OF CASES

Case 1. (A349418.) M. P., a girl of 15, was admitted to the Mayo Clinic, February 12, 1921, complaining of enlargement of both breasts. The family history and past history were irrelevant. Her menses had started during the previous year and were perfectly regular in time, duration, and amount of flow. About one year before she had noticed that her breasts were becoming larger. There had been steady progression in growth until at the time of her examination she was troubled with the inconvenience and burden of the weight. She had received X-ray treatment and internal medication.

At the time of examination the girl measured 5 feet, 3.5 inches in height, and weighed 122 pounds. Before the onset of the mammary enlargement she had weighed 100 pounds. Both breasts were greatly enlarged and hung to the level of the umbilicus. On palpation they were found "lumpy" in consistency. Aside from a trace of albumin and an occasional pus cell in the urine the remainder of the examination was negative.

Operation was performed February 17, 1921 (Pemberton), a simple amputation of the left breast being done. February 23, 1921, the same operator removed the right breast. The postoperative course was not remarkable and the patient was discharged in excellent condition March 10, 1921, with wounds entirely healed.

*Pathologist's report.* The left breast weighed 4200 grams in the fresh state; the skin was tense and slightly hypertrophied and the nipple flattened. There was no dermatitis. The areola was not discolored. On section a pearly white slightly succulent mass of fibrous tissue was found through which were scattered punctate translucent areas corresponding to mammary acini. The fibro-epithelial tissue was arranged as multiple circumscribed and encapsulated fibro-adenomata, and as diffuse white areas between the adenomata. The largest of the adenomata was about 5 centimeters by 9 centimeters and the smallest 1 centimeter; they contained parenchyma units more closely grouped and in greater number than in other areas. In the nipple zone the radiating lactiferous ducts stand out poorly, the interstitial areas having been filled with fibrous tissue to such an extent that the normal anatomy was greatly distorted. There were a number of small cysts, most of them grouped in the upper outer quadrant, and comprising structures ranging from minute dilated acini to definite cystic areas 5 millimeters in diameter and filled with a thin clear fluid. Possibly the most striking feature was the absence of fat. None was found in the

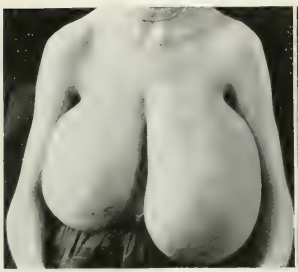

Fig. 1.

Fig. 2.

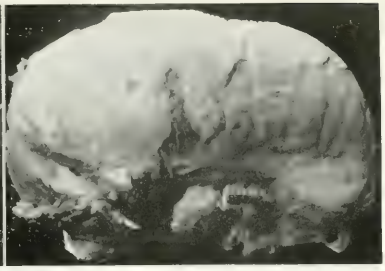

Fig. 3.

Fig. 1. Case 1. Fibro-epithelial type of massive hypertrophy. Girl aged 15.

Fig. 2. Case 1. Patient shown in Figure 1, 2 weeks after operation.

Fig. 3. Case 1. Cross section of right breast showing fibro-epithelial type of hypertrophy associated with fibro-adenomata. The macroscopic picture closely resembles that of the growth in Case 3.

mass of the breast or beneath the skin. Only a few patches of adipose tissue were seen toward the periphery and base. Microscopic sections from the fibro-adenomata showed the stroma to be about ten times as abundant as the parenchyma and to consist of loosely placed growing fibrous tissue in the process of differentiation. The stroma cells were mostly spindle-shaped with a faintly eosinophilic cytoplasm and oval or elliptical nuclei which take a light basophilic stain. There was a diffuse stippling of the nucleus with chromatin particles and in some cells small though definite nucleoli, single or double. No mitotic figures were observed. In some instances the cell differentiation was not so complete, the contour being more circular than ellipsoid, the nucleus larger and staining more faintly, and the nucleoli more prominent. Cell polarity was maintained fairly well, the axes of the spindles being parallel in most places. An occasional small lymphocyte and a few plasma cells were noted. Only a few capillaries traversed the field. The epithelial elements were arranged in acinous form, some being circular and others irregular in contour; some were cystic and dilated, some elongated. The irregularity of the acini seemed to be due to the crowding in of fibrous tissue rather than to the reduplication and piling up of layers of cells. The adenoma as a whole was circumscribed and encapsulated; its surface was covered by the two-layered mammary epithelium, a condition which suggested that the whole mass had protruded itself into a canaliculus and might well account for the fact that the process has been described by some authors as "diffuse intracanalicular fibro-adenoma." The individual acini were lined with two layers of epithelium presenting a striking illustration of cell hypertrophy and of the regenerative process described by MacCarty as primary cytoplasia. Thus the inner layer consists of large cuboidal cells completely differentiated, that is having perfect polarity, strongly basophilic cytoplasm and karyoplasm, and granular nuclei and nucleoli which are not prominent. The elements composing the outer layer were of the nature of tissue reserve cells (textoblasts). In addition to extreme hypertrophy these cells showed morphological signs of reproduction and were still in the process of differentiation. The cytoplasm was hydrophic and even vesicular in some instances; the nucleus was large and stained lightly; the nuclear granulations were finer and in a few cells a small nucleolus was seen. There was no cellular migration or breaking through of the so-called "basement membrane" at any point. Many acini contained a slightly eosinophilic fluid. This was probably of the same nature as the material found in the cysts.

Sections from the diffuse fibro-epithelial areas not associated with fibro-adenomata showed the stroma to be hundreds of times more abundant than the parenchyma. The fibrous tissue was highly differentiated and markedly eosinophilic, being loosely arranged with small interstices between the bundles. In some areas the fibers had taken on a wavy appearance. The nuclei dotting the field were typical of normal fibrous tissue, that is, spindle-shaped, markedly basophilic, and small. Occasional lymphocytes were found but there was nothing to suggest an inflammatory reaction. The sparse parenchyma units in certain areas again consisted of acini with an inner layer of normal differentiated cells (textocytes) and an outer layer of tissue reserve cells (textoblasts) showing all degrees of hypertrophy and variable signs of reproductive activity. There was a variation also in the size of the acini in such areas of the breast. In the acini with marked cystic dilatation the textoblasts of the outer layer was very inactive and all the cells lining the cysts were of the flattened cuboidal type.

The right breast weighed 2500 grams and was essentially the same type of structure as the left breast except that it contained only one adenoma

Fig. 4. Fig. 5. Fig. 6.

Fig. 4. Case 1. Section from fibro-adenoma. Note the irregularity of acini and proliferation of epithelial and fibrous elements. (×50.)

Fig. 5. Case 1. Interadenomatous area. Note the high degree of differentiation in stroma and two layered mammary acini, with hypertrophic cells. (×50.)

Fig. 6. Case 1. Section from interadenomatous area. Note the high degree of differentiation in stroma. Also the hypertrophy and proliferative activity (primary cytoplasia) of the acinar cells.

Fig. 7. Fig. 8.

Fig. 7. Case 1. Acinus from such a field as Figure 6. Note the huge cells in both acinar layers. The outer cells (textoblasts) are in the process of differentiation. (×500.)

Fig. 8. Case 1. Showing the intracanalicular tendency of the growth in certain areas.

2.5 centimeters by 3 centimeters. This adenoma occurred near the nipple zone where the radiating ducts stood out more clearly than in the specimen from the left side. The same histological features were found as in the left breast.

A pathological diagnosis was made of bilateral massive hypertrophy of the breast, fibro-epithelial in type and associated with multiple fibro-adenomata and numerous small cysts (Figs. 1 to 8).

Case 2. (A242030.) M. S., a girl aged 19, came to the Clinic August 8, 1918, complaining of enlarged breasts. The family history and past history were unimportant. Menstruation had begun at the age of 14. Periods were regular but lasted only one-half day, the amount being very small, with severe pain during this time. The breasts began to increase in size just before puberty and had been growing progressively larger. There had been no pain but the appearance of the enlarged breasts had been a source of mortification.

Examination showed a well developed girl, weighing 178 pounds, normal weight being about 150 pounds. She had mild tonsillitis and dental caries. The breasts were very large and pendulous, hanging nearly to the umbilicus. The enlargement seemed to be diffuse and no nodules or circumscribed tumors were palpated. The patient was advised to return home and wait, in the hope that the breasts might undergo spontaneous regressive changes.

April 13, 1920, the patient returned to the Clinic stating that for the past 2 months she had been suffering greatly with shooting pains in both breasts, chiefly in the upper outer quadrant. The breasts themselves had remained stationary in size, and had not shown any changes associated with the menses which had continued scanty and painful.

Examination revealed essentially the same condition. The patient insisted on operation and in consequence a simple amputation of both breasts was performed April 21, 1920 (Hedblom). The postoperative course was uneventful, and the patient was discharged in good condition May 5, 1920. She was heard from again in April, 1921.

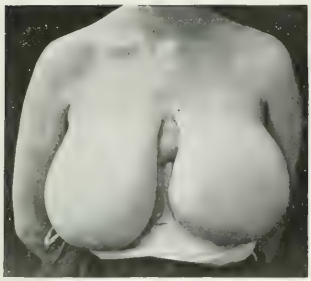

Fig. 9.

Fig. 10.

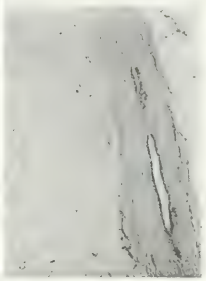

Fig. 11.

Fig. 9. Case 2. Adipose type of massive mammary hypertrophy. Girl aged 19.

Fig. 10. Case 2. Cross section through breast showing preponderant adipose tissue streaked with fibro-epithelial strands.

Fig. 11. Case 2. Photomicrograph of typical area of fat traversed by fibrous tissue band containing elongated acini. This picture is almost identical with areas from Case 4. (×50.)

She had not menstruated since the operation and had complained of frequent attacks of indigestion accompanied by vomiting. Her weight was 175 pounds.

*Pathologist's report.* The right breast weighed 2000 grams. The skin was slightly thickened and the nipple flattened. The mass of the breast was made up of fat which was divided into a number of lobules by septa of fibrous tissue variable in size and frequently confluent. The parenchyma was sparse in amount and distribution; it was limited entirely to the fibrous tissue, none being found in the fat itself. The nipple zone also was invaded by the adipose overgrowth and the normal anatomy was obliterated. Microscopic sections showed adipose tissue traversed by bands of highly differentiated eosinophilic fibrous tissue. There was a total absence of acini from the fat; a few occurred as elongated units in the fibrous bands. The lining cells were disposed in two layers, were slightly hypertrophic and showed a tendency in some places toward textoblastic proliferation, although not nearly so marked as that noted in Case 1.

The left breast weighed 2250 grams and was identical in structure with the right.

A pathological diagnosis was made of bilateral massive hypertrophy of the breast of the adipose type (Figs. 9 to 11).

Case 3. (A276920.) Mrs. R. C., aged 36, was admitted to the Clinic June 30, 1919, complaining of enlarged breasts. She had been married 10 years and had one child nearly 5 years of age. With the exception of an appendectomy performed 6 years before, her past history was negative. Her menses had always been regular in time, amount, and duration, and without pain. The onset of her present condition was associated with her only pregnancy 5 years before when she noticed that both breasts were beginning to enlarge. She was delivered at term of a normal child which she nursed without difficulty. However, her breasts continued to increase in size, and although they did not cause pain she wished to be relieved of their troublesome weight as well as of the impediment which they placed on her normal everyday movements.

The examination revealed nothing important aside from the mammary glands, both of which were enormously hypertrophied, hanging almost to the pubes. On palpation areas of thickening were felt in different portions.

A simple amputation of both breasts was performed July 17, 1919 (Judd). The postoperative course was uneventful and the patient was discharged July 25, 1919, with wounds healed and in excellent general condition.

*Pathologist's report.* The left breast weighed 2530 grams. The skin was thickened and the nipple flattened. There was no sign of dermatitis or superficial discoloration. On cross section the specimen was found to consist almost entirely of fibrous tissue studded with punctate translucent areas of parenchyma. There were a number of circumscribed encapsulated fibro-adenomata, the largest being 15 centimeters and the smallest 7 centimeters in diameter. There was little or no fat. Sections from the adenomata revealed a stroma composed of differentiating and differentiated fibrous tissue, and of acini presenting the hypertrophy and exaggerated primary cytoplasia or cellular regenerative changes which were described in Case 1. The interadenomatous areas consisted of well differentiated fibrous tissue with areas of

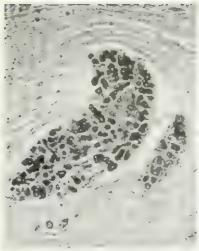

Fig. 13.

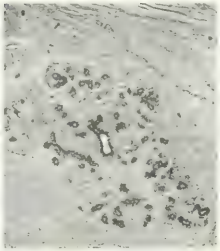

Fig. 14.

Fig. 13. Case 3. Typical lobular grouping of acini.
Fig. 14. Case 3. Intermediate stage of destruction of lobule by invasion of fibrous tissue.

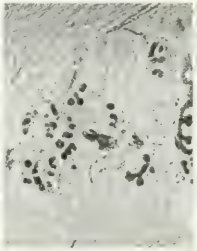

Fig. 15.

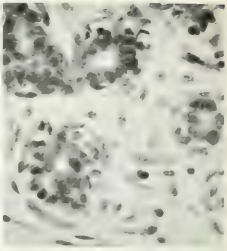

Fig. 16.

Fig. 15. Case 3. Late stage in destruction of lobule by ingrowth of fibrous tissue.
Fig. 16. Case 3. Acini showing exaggerated primary cytoplasia. (×500.)

parenchyma whose acinous units tended to be grouped together after the manner of the parenchyma in the breasts of parous women. However, there was a further interesting feature in this case. The acinar groups in certain fields were circumscribed and while there was no definite capsule, the surrounding fibrous tissue was arranged in a concentric manner. In other areas this arrangement was disturbed by a peri-acinar development of fibrous tissue. In the earliest stages of this process proliferating and differentiating fibroblasts may be seen between the acini. In other areas a further stage was found. The fibrous tissue had developed in the acinous area to such an extent as to compress the parenchyma and cause at first the isolation, later the atrophy, and finally the obliteration of individual mammary alveoli. That the epithelial cells were not without resistance was shown by the fact that in many areas, in the layer of tissue reserve cells (textoblasts), the cells were enlarged and showed morphological signs of reproductive activity.

Fig. 12. Case 3. Fibro-epithelial type of massive hypertrophy which began with pregnancy.

The right breast weighed 2500 grams. The gross and microscopic pictures were essentially identical with those of the left breast. The largest fibro-adenoma measured 3 centimeters and the smallest 1 centimeter in diameter.

A pathological diagnosis was made of bilateral massive hypertrophy of the breast occurring in association with pregnancy; the fibro-epithelial type with multiple fibro-adenomata (Figs. 12 to 16).

Case 4. (A343701.) Mrs. N. F., aged 41, was admitted to the Clinic December 13, 1920, complaining of large, painful breasts. She had been married 21 years and had had three children. Her youngest child was 13. She had not had further pregnancies. Her menstrual history was normal in time of onset, regularity, and flow. She had had an abdominal operation 10 years before of which she did not know details. The onset of her condition had begun 1 year before and 12 years subsequent to her last pregnancy. About this time she also began to suffer from frequent severe headaches and observed swelling of wrists and ankles. Her breasts grew progressively larger until at the time of examination their weight, and the pain, had become a burden.

On examination the patient weighed 166 pounds; her blood pressure was systolic 120, and diastolic 80. There was a slight œdema of the legs and a trace of albumin in the urine. Both breasts were greatly enlarged. The right breast about 10 times normal size, was at least one and one-third times

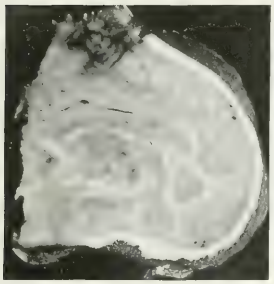

Fig. 17.

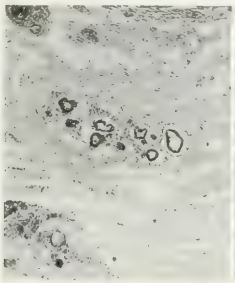

Fig. 18.

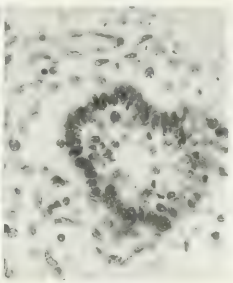

Fig. 19.

Fig. 17. Case 4. Cross section of breast showing distribution of fatty tissue and fibro-epithelial bands which divide the fat into lobes. The histological structure is similar to that in Figure 11, Case 2.

Fig. 18. Case 4. Fibro-epithelial band traversing fatty tissue. The acini show marked primary cytoplasia. (×50.)

Fig. 19. Case 4. Acinus from field in Figure 18, showing primary cytoplasia.) (×500.)

as large as the left. Over both glands the superficial veins stood out prominently. On palpation no lumps or nodules could be detected.

December 15, 1920, a simple amputation of both breasts was performed (Harrington). The postoperative course was uneventful. The patient was discharged from the hospital December 31, 1920, with wounds healed and with general condition excellent.

*Pathologist's report.* The right breast weighed 2285 grams. The skin was tense, slightly thickened, and the nipple flattened. On section the mass of the breast was found to be made up of pale lemon-colored fat, traversed by a number of connective-tissue bands which divided it into a number of lobular portions. No parenchyma was seen in the fat and the normal anatomy of the nipple zone was obliterated by the adipose overgrowth. Microscopic sections showed the fibrous tissue, as in Case 2, to be highly differentiated and markedly eosinophilic. It contained relatively few acini, those present being lined by a double layer of greatly hypertrophied cells. The cells of the outer layer (textoblasts) were in the process of differentiation and showed the signs of reproductive activity described in the other cases. The acini themselves were small and compressed by the surrounding fibrous tissue. The reproductive activity (primary cytoplasia) of these cells could well be interpreted as a species of biological resistance to their obliteration by the compression brought about by the overgrowth of fatty tissue.

The left breast weighed 1850 grams. The structure was identical with that of the right and needs no separate description.

A pathological diagnosis was made of bilateral massive hypertrophy of the breast, the adipose type, occurring in a parous patient unassociated with pregnancy (Figs. 17–19).

SUMMARY

1. Massive hypertrophy of the breast is of two types: (a) fibro-epithelial and (b) adipose.

2. It may occur between the ages of 12 and 48 but is most frequently associated with puberty or pregnancy.

3. The normal development of the breast seems to depend on the ovary, and there is evidence which strongly suggests that the massive hypertrophy may be etiologically related to an ovarian malfunction.

4. If spontaneous regression of the process fails to occur, surgical amputation is, at present, the preferred treatment.

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# BACTERIOLOGY AND PATHOLOGY OF FALLOPIAN TUBES REMOVED AT OPERATION [1]

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From the Pathologic Laboratory and Gynecologic Service of St. Luke's Hospital

THE present report covers an investigation of fallopian tubes from nearly three hundred patients. One hundred and ninety-two of these have been subjected to most painstaking bacteriological and histological study.

Before considering diseased tubes, I wish to make a brief survey of associated previous studies which concerned infections of the external genitalia, the cervix, and the body of the uterus. Investigation of the endometrium of 118 uteri, removed to remedy various pathological conditions,[2] showed that chronic endometritis, as a clinical entity, is very uncommon; persistent infection of the endometrium almost never exists unless maintained by other lesions, such as cervicitis or cellulitis. During the same study of the endometrium, in certain cases normal scrapings were obtained from the uterus; then, several days thereafter, in the endometrium secured by hysterectomy, many bacteria and histological evidence of acute endometritis were found. It would appear, therefore, that curettage is not to be regarded as a perfectly harmless procedure. In the work on tubal infections which is herewith reported, evidence has been obtained which serves to emphasize particularly the dangers of curettage or other uterine instrumentation in patients whose pelvic organs already harbor living bacteria.

Although the corporeal endometrium tends to remain free from chronic infection, histological examinations and cultures from cervices obtained at operation have revealed that bacteria frequently lodge in these tissues, notably in the vicinity of the actively-secreting glands of the mucosa. It has been found, also, that granulations and strictures are often present in the canal of the cervix; the frequency and importance of these granulations and strictures seems not to have been sufficiently recognized.

It should be noted, also, that infection is often present in the upper cervix as high as the level of the internal os. This fact demands special emphasis for several reasons: first, the channel is more constricted near the internal os and infectious processes are particularly stubborn here because free drainage is easily interfered with; second, upper cervix discharges persistently bathe the lower cervix with infectious material and prevent recovery of the latter; again, surgical removal is exceedingly difficult, and even the ingenious operation of Sturmdorf is not sufficiently extensive to yield consistently good results in this type of case.

That special importance attaches to infections of the cervix is evident not only from the disappearance of discharge, but also from notable improvement in general health which follows complete removal of the endocervix or dilatation and radium destruction of the hypertrophic cervical glands.

One other source of chronic leucorrhœa, although less important than disease of the cervix, must be emphasized. This is infection of Skene's ducts. Destruction of these ducts very frequently results in cessation of persistent vulvovaginitis.

## Bacteriological Study
(See Table)

The diseased tissues from the 192 cases submitted to bacteriological study have been placed in sterile towels immediately upon removal from the abdomen. Smears have been made and all except portions saved for histological examination have been thoroughly ground and the entire material inoculated into culture media. A considerable variety of media has been used. Meat-infusion-ascites-blood-agar, under partial oxygen tension, had yielded most uniform success in cultivation of the gonococcus.

For convenience in study, these patients have been arranged in three groups: those

[2] A combined bacteriological and histological study of the endometrium in health and in disease. Surg., Gynec. & Obst., 1918, xxvi, 170.

[1] Read before the American Gynecological Society, Boston, June, 1921.

TABLE SHOWING INCIDENCE OF BACTERIA IN PATHOLOGICALLY ALTERED FALLOPIAN TUBES FROM 192 PATIENTS

| Type of Cases | Number of cases | No growth | Growth | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total number | Gonococcus | Non hæmolytic streptococcus | Hæmolytic streptococcus | Anaerobic streptococcus | Bacillus coli | Mixed growth | Bacillus proteus | Tuberculosis |
| Gross evidence of active inflammation. | 61 | 29 | 33 | 10* | 5* | 2 | 5* | 3 | 3* | 1 | 3* |
| Histological (grossly negative) evidence of active inflammation . . . | 38 | 27 | 5 | | 4 | 1 | | | | | 6 |
| No evidence of active inflammation | 90 | 90 | 0 | | | | | | | | |
| Total | 192 | 146 | 38 | 10 | 5 | 4 | 5 | 3 | 3 | 1 | 9 |

*Both gonococci and non-hæmolytic streptococci, 1 patient; anaerobic streptococci with other growth, 1 patient; tuberculosis with anaerobic streptococcus infection, 1 patient.

with grossly active inflammation, those with inflammation demonstrable only upon microscopic examination, and those without definite evidence of an active process.

Cultures were positive in 38 cases, as follows: gonococcus, 19; non-hæmolytic streptococcus, 6; hæmolytic streptococcus, 3; anaerobic streptococcus, 5; bacillus coli, 3; mixed infection, 3; bacillus proteus, 1. Nine revealed tuberculosis.

*Gonococcus, 19.* It should be emphasized that the cultures have been made from the entire thoroughly ground fallopian tube, with the exception of certain portions reserved for histological examination. In material so studied it has never been possible to obtain gonococci from patients who failed to reveal gross evidence of active inflammation at the time of operation (Table).

It has heretofore been impossible to form a definite clinical estimate of the length of time which the gonococcus remains viable in the fallopian tubes; this is particularly true of those cases in which patients give evidence of recurrently active or persistent tubal disease. It has long been known that gonococci soon disappear from the tubal mucosa, but proof that infection does not persist in the deeper tubal structures has been wanting. Whether the gonococcus produces a chronic salpingitis or these patients suffer from repeated gonorrhœa of the tubes seems to me an important issue. It is, therefore, of interest to note that in this work, in all of which cases the fallopian tubes were ground and promptly cultured according to approved modern methods, it has rarely been possible to obtain viable gonococci from patients who have been free from fever and leucocytosis for a period of more than 10 days or 2 weeks. The fact that good growth was obtained in more recent tubal infections is evidence of satisfactory cultural methods. In view of the many cases studied in this way I feel warranted in the deduction that the gonococcus lives but a short time in the tube; in other words, it seems that the fallopian tube is not to be regarded as a focus of chronic gonorrhœal infection. Persistently active gonorrhœa of the tubes is evidently ascribable either to recurrence of infection from without or repeated invasion of bacteria from the chronically infected lower genital tract.

Detailed description of these 19 cases which yielded gonococci in cultures would not be of material interest. It will perhaps be a surprise to many clinicians that secondary mixed infection has not often been encountered. Only one patient, with exceptional persistence of the gonococcus, merits special attention. This patient, free from symptoms of an acute nature, had been curetted for relief of leucorrhœa and one tube had been removed 6 months before admission

to our service. We found an abdominal fistula communicating with the tube which remained. Upon removal, this tube yielded the gonococcus in pure culture. In so far as could be ascertained, there had been no recent exposure to fresh infection and no instrumentation of the cervix.

The relation of instrumentation to gonococcal disease of the tubes may be illustrated by mention of 5 other patients; 3 of these, previously subject to slight pelvic discomfort, had elsewhere been curetted for relief of leucorrhœa, and thereafter suffered from constant tubal distress; at operation all revealed salpingitis with adhesions. Two others (these treated throughout by me) acquired subacute mild tubal infection following intracervical silver nitrate treatments for relief of leucorrhœa. It seems that there is distinct danger of low-grade salpingitis from repeated instrumentation of the infected cervix.

*Non-hæmolytic streptococcus*, 6. Not only in the non-hæmolytic group, but also in infections with other types of streptococci, pathological evidence of an active inflammatory process was sometimes encountered long subsequent to the introduction of infection; furthermore, bacteria were more persistent than the pathological evidence would indicate. Streptococci were occasionally isolated in pure culture many months, or even years, after the acute process had subsided.

Non-hæmolytic streptococci were isolated from the tubes of 2 patients with grossly active inflammation and from 4 in whom the microscope was required to reveal that an active process still persisted (Table).

From a patient with history of 2 years' illness, in whom there was a right pyosalpinx and left hydrosalpinx with cystic ovary, both streptococci and gonococci were found in cultures.

Another patient gave history of instrumental termination of a 6 weeks' pregnancy in 1918. Two months later, fearing another pregnancy, she inserted a catheter and also received intra-uterine instrumentation by a physician. Offensive leucorrhœa and pelvic discomfort, increasing in severity, persisted until 1920, when the patient came under the care of Dr. Watkins. Cervical treatments were tried for 1 month. Operation at the end of that time revealed enlarged tubes which were convoluted, but not nodular. The fimbriæ were swollen, slightly adherent, not occluded. Firm adhesions completely covered the retroverted uterus and tubes. Bacteriological study revealed streptococci.

One patient with typical non-hæmolytic streptococcus infection was 48 years of age, with four healthy children. She gave history of two spontaneous miscarriages. Manual removal of the placenta after the first miscarriage, 23 years ago, had been followed by infection with recurrence every few months from that time, the last attack 7 months prior to operation. The abdomen, when opened, revealed monster hydrosalpinx, one ovary of double size, and a large uterus. Numerous colonies of non-hæmolytic lancet-shaped, short-chained streptococci, non-virulent for rabbits, were present in cultures.

The other 3 patients whose tubes yielded non-hæmolytic streptococci all gave history of prolonged illness subsequent to abortion with infection.

*Hæmolytic streptococcus*, 3. A patient who had long suffered from moderate pelvic pain had elsewhere been dilated by means of a laminaria tent and then curetted. She entered our service acutely ill. A mass, apparently in the right tube, extended into the cul-de-sac and yielded foul pus on vaginal puncture. Cultures showed great numbers of hæmolytic streptococci.

Another patient, with history of gonorrhœal infection, had a fist-sized tubo-ovarian inflammatory mass; the other tube showed typical gonorrhœal changes upon both gross and microscopic examination. Smears and cultures contained many long-chained hæmolytic streptococci, but no gonococci. It appears probable that there had been a primary gonorrhœal salpingitis with implantation of subsequent streptococcus infection.

Hæmolytic streptococci were obtained from one patient, 34 years old, with history of abortion from an unknown cause at the age of 29. She suffered from severe persistent pelvic pain. Drainage, performed 2 months before operation, yielded an abundant tenacious fluid containing gram-positive diplo-

cocci. Upon abdominal section both tubes and ovaries were found buried in old inflammatory exudate and adhesions, and were difficult to identify. Histological examination of the tubes revealed thickening, large areas of lymphocytic infiltration in the deep wall of the tube, and an intact endosalpinx with much cellular exudate, including a moderate percentage of plasma cells. Cultures yielded enormous numbers of hæmolytic streptococci. Rabbits injected intravenously with these bacteria developed purulent arthritis and acute nephritis.

*Anaerobic streptococcus, 5* (see "mixed growth"). A large patient, with postabortive pelvic infection of 2 years' duration, failed to improve after many months of palliative treatment. At operation there was ruptured a thin-walled cystic mass deeply buried in the left pelvis. The contents were serous but foul-smelling. The tube and ovary on that side were adjacent to the mass, much enlarged and firmly adherent. The resistance of adhesions was particularly noted. Cultures contained numerous colonies of anaerobic streptococci.

A patient with one son wished to avoid further child-bearing. She had been repeatedly aborted without serious trouble until, finally, two successive attempts to rid the uterus of another pregnancy were followed by severe infection. Upon subsidence of acute symptoms she remained incapacitated because of persistent distress in the right lower quadrant, and continued to suffer greatly at the time of my first examination, 6 months after the onset of infection. A cyst-like inflammatory mass was palpable in the right pelvis. There was no fever, no leucocytosis. At operation was found a foul-smelling right ovarian abscess the size of a grape-fruit, the right tube firmly adherent and semi-necrotic, the fimbriæ free. The other tube was also adherent to the abscess and œdematous, but was free at the fimbriated extremity. Smears of the pus revealed numerous gram-positive diplococci and a smaller number of small gram-negative bacilli. In cultures, the gram-negative bacilli failed to develop, but anaerobic streptococci were present in rich pure growth. These streptococci were not virulent for experimental animals.

A woman of 43, married 6 years, had never been pregnant. The history and physical examination indicated a persistently recurrent gonorrhœal infection of the fallopian tubes. Upon removal, the tubes were found to be considerably enlarged, with greatly thickened walls and closed fimbriated ends, the lumen filled with green-yellow pus. A rich growth of long-chained anaerobic streptococci was recovered in pure cultures. There were no gonococci.

A patient who had been operated upon 3 years before, for chronic disease of the tubes, presented an abdominal sinus. This sinus communicated with an enormous necrotic ovary by means of an almost solid fistulous tract, the size of one's little finger. Smears and cultures from the necrotic material yielded great numbers of anaerobic streptococci. Histological examination showed typical tuberculous changes.

*Bacillus coli, 3.* A patient married 37 years, never pregnant, with history of chronic vesical distress and chronic pelvic pain, had greatly enlarged tubes closed at the fimbriated ends. One tube contained thick yellow pus; all other evidence indicated chronic salpingitis of gonorrhœal origin. Bacillus coli was recovered in pure culture from the pus as well as from the ground wall of the tube.

A girl with history of gonorrhœal infection for over 1 year was operated upon for relief of a persistent ovarian abscess. This abscess contained nearly a litre of pus and revealed numerous colon bacilli in smears and cultures. There were no gonococci. The chronically diseased tubes presented both gross and microscopic changes typical of gonococcal infection.

A somewhat similar case is that of a young woman with an infected thick-walled cyst of the ovary. Both tubes were enlarged and chronically inflamed, with pathological changes typical of gonorrhœal disease. Cultures revealed pure growth of bacilli of the colon group.

From the tubes of several other patients occasional colonies of colon bacilli were isolated.

*Mixed growth, 3.* In two patients, whose clinical history and external genital examination pointed toward venereal infection, persistent tubo-ovarian abscesses were encountered. Numerous bacteria, chiefly gram-negative cocci, were obtained. There were no gonococci, but pathological changes were typical of that disease.

In this connection it should be mentioned that colonies of staphylococci and diphtheroid bacilli, notably the former, have been fairly numerous throughout this work. Except when many colonies have been present, the control histological study has permitted the inference that they were incidentally present; more numerous colonies have a few times been suspected to play a more important rôle.

A patient who was free from venereal disease and had been infected as the result of criminal abortion, was thereafter curetted and subsequently underwent vaginal drainage for an accumulation of pus in the pelvis. Symptoms persisted from that date. At operation, 1 year later, we found a greatly enlarged left ovary containing a small amount of foul pus. The tubes were densely adherent, three times normal size and very firm; the fimbriæ were open. Both smears and cultures revealed anaerobic streptococci and fusiform bacilli; also a considerable mixture of other bacteria, notably staphylococci.

*Bacillus proteus, 1.* A patient without history or external evidence of venereal infection, whose husband upon examination revealed no suggestion of gonorrhœa, was operated upon for relief of pelvic infection. Both tubes were moderately enlarged and one contained mucus and blood. The fimbriated extremities were not occluded. Bacteriological study revealed a rich growth of bacillus proteus in pure culture. Histological examination showed an active inflammation of the endosalpinx. There were numerous polynuclear leucocytes and many round cells, of which a large proportion were plasma cells. The inflammation was restricted to the vicinity of the tube lumen; the deeper mucosa and muscle layer were essentially free from invasion. Integrity of the columnar epithelium and absence of adhesions between the folds of endosalpinx were also noted.

## Pathology [1]

### A. Gonorrhœal disease of the tubes

From the clinical history, examination of the external genitalia, and evidence obtained at operation, together with laboratory study of the tubes in this series of nearly 300 patients, it has been possible to determine that gonococcal infection was responsible for the pathological changes in more than 70 per cent of the cases. Approximately 10 per cent more were thought to have been primarily infected with the gonococcus, but this could not be determined with certainty.

The gross features of recently diseased gonorrhœal tubes require no description. That they become enlarged, particularly at the outer ends, that they fall downward and backward, that the fimbriæ become occluded, and that adhesions are numerous, is common knowledge. It is less well known that after cessation of the active process, those tubes which have undergone only catarrhal changes, without retention of fluid within the tube, rarely show much enlargement; often they are atrophic. There is a tendency to remain indurated and somewhat nodular, and, whenever other lesions persist, it is usual to find occlusion of the fimbriæ.

Several tubes, with only slight changes, have served to verify the mechanism of tubal occlusion described by Ries.[2] It appears that inflammation of the serosa is followed by scar formation which, upon contraction, makes a more or less complete purse-string closure, with inversion of the fimbriæ.

More frequently, perhaps, and notably in the presence of ovarian infection or other extensive inflammation, the tube occludes by plastering itself upon the ovary, uterus, or broad ligament.

It has been particularly noted that a single attack of salpingitis seldom results in marked permanent increase in thickness of the tube wall. Greatly thickened tubes are most often

[1] For literature concerned with the pathology of salpingitis of acute infectious origin, the reader is referred particularly to the following: Schridde, Deutsch. med. Wchnschr., 1909; also Verhandl. d. Gesellsch. deutsch. Naturf. u. Aerzte, Leipzig, 1908, lxxx, 2 Th., 2 H., 47; Amersbach, Monatschr. f. Geburtsh. u. Gynaek., 1910, xxxii, H. 4, 444; Heynemann, Ztschr. f. Geburtsh. u. Gynaek., 1912, lxx, 870; Ploeger, Arch. f. Gynaek., 1911, xcv, 634.

[2] Ries, E. The mechanism of occlusion of the tube. Am. J. Obst., 1909, lx, No. 2.

associated with repeated exposures. If the patient can be early isolated from the source of her infection there is reason to expect moderate tubal changes. Only occasionally are gonococci sufficiently virulent to make an exception to this general rule.

Persistent pyosalpinx exemplifies gonorrhœal infection in severe form; it is particularly characterized by hyperplasia and induration of the tube wall. In a lesser measure the same holds true for the tubal changes of hydrosalpinx. The belief that hydrosalpinx and pyosalpinx are fundamentally different lesions has not been borne out by this study. A comparison of histological material reveals innumerable gradations from one to the other.

In greatly thickened old tubes, blood vessels are very numerous. Aside from recognized tubal pregnancy, none of which cases is wittingly included, there have been studied more than half a dozen such tubes with rich blood supply in which there was extensive hæmorrhage within the tube lumen. By means of serial sections it was possible to demonstrate the site of blood vessel rupture in one case. The question arises whether we have not placed too much reliance upon hæmatosalpinx as a dependable evidence of tubal gestation. Possibility of this error is increased by the fact that microscopic examination of these blood-filled, greatly thickened tubes reveals an overgrowth of distorted villi which might easily be mistaken for the chorionic villi of pregnancy.

So-called "salpingitis nodosa" has been the subject of much discussion. There has been a tendency to ascribe all of these tubal nodulations to gonorrhœal infection. Some few authors have adhered to the belief that they are due to congenital anomalies. All are agreed that the majority of such tubes reveal, histologically, nests of gland-like columnar epithelium buried beneath the mucosa. My experience agrees with that of Ries,[1] who asserts that nodules of the tube are due to many causes, inflammatory and non-inflammatory; the microscope best explains the etiology of any doubtful case. It would appear that the vast majority are inflammatory in origin, notably the result of gonorrhœal infection; less often tuberculosis is responsible. That gland-like nests of cells need not necessarily be present is evident from study of a tube which revealed, grossly, a typical picture of salpingitis nodosa, and microscopically presents an interstitial gonorrhœal abscess (Fig. 1). A grossly identical nodule, incidentally discovered at the time of appendectomy, was removed from a patient with many children and without history or evidence of infection; this proved to be an adenomyoma of the tube (Fig. 2).

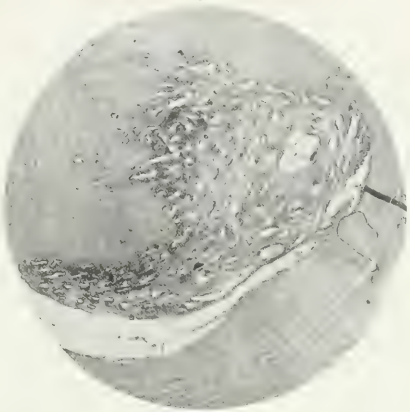
The adhesions encountered in gonorrhœal cases possess a distinctive clinical characteristic; they can be separated by manipulation or blunt dissection, without cutting. When the tubes and ovaries could not be freed in this manner, irrespective of the severity or duration of the salpingitis, there was evidence of infection with other bacteria. There was a single notable exception; a young married woman had been assaulted when a girl and at that time suffered from symptoms typical of gonorrhœal disease. External examination revealed evidence of healed infection which substantiated the history. At operation there was found a matting together of the pelvic viscera, such as has been encountered after extensive radium treatment of cancer cases. Although I was tempted to ascribe the pathological changes to an associated infection with other bacteria, neither history nor laboratory evidence justified that assumption. Upon two other occasions when very dense inseparable adhesions were encountered, there was no pre-operative history of disease other than gonorrhœal infection; it was subsequently learned, however, that both patients had previously undergone instrumental abortion with severe infection.

*Histology.* In the early stages there is swelling of the endosalpinx with more or less destruction of the columnar epithelium. Fusion of adjacent folds of villi is frequent; this is a characteristic feature. Later, the mucosa often becomes much crippled and distorted. Gland-like nests of columnar epithelium are sometimes found deeply buried in the wall of the tube and inflammatory diverticula extend far beneath the mucosa

[illegible]

Fig. 1.

Fig. 2.



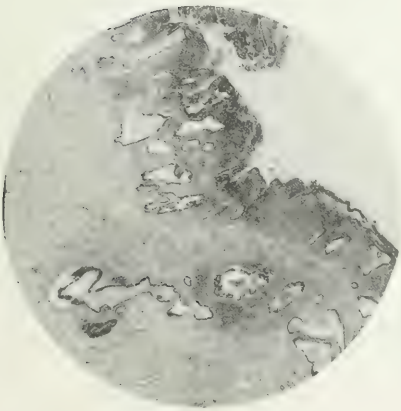


Fig. 3.

Fig. 4.

Fig. 1. Salpingitis nodosa. Microscopically, a gonorrhœal abscess in the tube wall.

Fig. 2. Salpingitis nodosa. Grossly identical with the nodule seen in Figure 1. Serial sections reveal an adenomyoma of the tube. Removed from a patient with many children and without history or evidence of pelvic infection.

Fig. 3. Gland-like nests of columnar cells buried in wall of tube. Gonorrhœal infection. Longitudinal and serial sections reveal that these nests communicate with the tube lumen.

Fig. 4. Mucosa of healed gonorrhœal tube; typical adhesions between villi.

(Fig. 3); this is particularly true of tubes with pyosalpinx or hydrosalpinx.

The cellular exudate of gonorrhœal salpingitis is not confined to the mucosa but penetrates all layers of the tube wall. The most intense inflammatory reaction, however, is in the mucosa, and here it persists until healing is complete.

Aside from polynuclear leucocytes, whose numbers vary in proportion to the activity of the process, lymphocytes and plasma cells predominate. The exact diagnostic significance of plasma cells as evidence of gonorrhœal infection requires mention. Plasma cells are characteristic of gonorrhœal salpingitis and most strongly suggest this disease. But it may be positively stated that they are not to be depended upon as pathognomonic; they are often present and are sometimes numerous after non-gonorrhœal postabortive infection.

In the course of time, if there has been only a catarrhal salpingitis, there may remain very little change in the tube. All cellular exudates may eventually disappear, but, even with excellent recovery, the microscope reveals adhesions between villi (Fig. 4) and an unusually abundant blood supply.

After pyosalpinx, and to a lesser degree after hydrosalpinx, all histological lesions in the healed tube are more extreme than those which follow simple catarrh of the tube. In that portion not thinned out by fluid pressure there is hyperplasia of the wall and a varying amount of distortion of the muscle layers. The previously mentioned nests of columnar epithelium are particularly worthy of mention. Longitudinal or serial sections of the tube reveal that most of these deeply buried gland-like nests of columnar cells are really connected with the mucous lining of the tube.

### B. TUBAL DISEASE OF OTHER ACUTE INFECTIOUS ETIOLOGY [1]

In somewhat more than 15 per cent of these patients the tubal pathology is believed to have been entirely due to other pus-producing bacteria, notably streptococci.

Tabulation of the gross changes encountered in these non-venereal infections reveals that, when salpingitis occurred, it was most often but a part of the pathological picture rather than the chief lesion. Cases in which the tubes present the essential pathology seem not usual in such infections. The most notable exception to this is the fairly frequent occurrence of non-gonorrhœal hydrosalpinx. Occasionally pyosalpinx complicates a puerperal abscess of the ovary.

The diagnosis of salpingitis of a non-gonorrhœal nature is usually possible even in the absence of growth in cultures. As just mentioned, the tubal changes may present but a minor part of the picture. The typical lesion consists in perisalpingitis with adhesions which vary in number and density (Fig. 5). The adhesions are often delicate and few; this seems particularly to characterize mild colon bacillus infections. On the other hand, virulent streptococci leave most dense adhesions without available lines of cleavage. Firmly bound, matted tissues, which resist all attempts at blunt dissection speak strongly for streptococcus or tuberculous infection. Even though there has been a primary gonorrhœal salpingitis, adhesions which necessitate extensive cutting suggest that other infection has also been present.

The tube walls may reveal little change. Palpable induration is often wanting. The fimbriated ends tend to remain patulous. The microscope most often fails to show extensive changes of the endosalpinx.

Even if there be extensive inflammation of the endosalpinx, few adhesions form between the folds of the mucous membrane provided the fimbriated ends of the tubes remain open (Fig. 6).

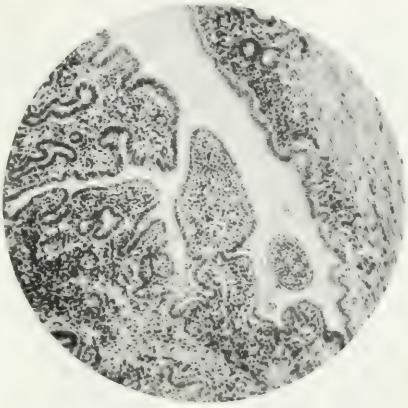
There is much less desquamation of the epithelium, and plasma cells are less common than in gonorrhœal infection. The assertion that the villi are never so filled with cellular exudate and are never so "fat" as in gonorrhœal disease, is contrary to my experience.

In those much less common cases which present occluded fimbriæ and accumulated fluid within the tube, attempts to differen-

[1] The conclusion that a gonococcal tube is present is based upon negative evidence as well as upon examination of the diseased pelvic organs. When possible, an examination of the husband, including a search of the urine for residual evidence of old infection, has been made. Uncertain cases, those patients with thickened Skene's ducts, urethral granulations, Bartholin duct involvement, or with history of notable urinary infections are excluded from the non-gonorrhœal group.

Fig. 5.

Fig. 6.



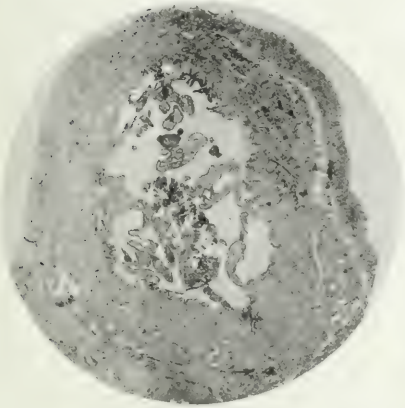


Fig. 7.

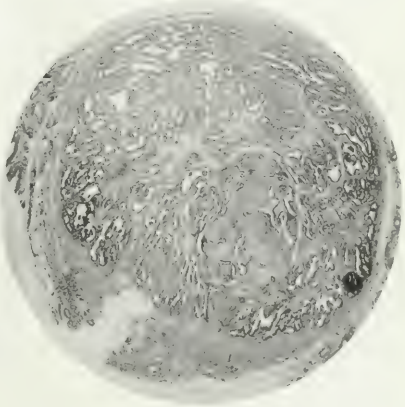


Fig. 8.

Fig. 5. Typical non-gonorrhœal tubal lesion. Marked perisalpingitis with adhesions. The fimbriæ are usually free, the mucosa little affected.

Fig. 6. Non-gonorrhœal tubal disease, which is less common than that which is shown in Figure 5. Even with extensive inflammation of the endosalpinx, as here shown, few adhesions form between the villi provided the tubes remain patent. This patient had persistent tubo-ovarian streptococcus infection; operation 1 year subsequent to pelvic drainage of puerperal abscess.

Fig. 7. Streptococcus hydrosalpinx; a less common type of non-gonorrhœal tubal lesion. Such tubes reveal adhesions between villi, buried nests of columnar cells, and other features supposed to characterize gonococcus infection; histological evidence alone is inadequate for positive differential diagnosis.

Fig. 8. Tuberculous salpingitis. The mucosa is the chief seat of infection. Hyperplasia of the mucosa, dense adhesions between villi, great numbers of giant cells, and extensive tubercle formation are usual microscopic features.

tiate from the corresponding tubes of gonorrhœal disease have been unsatisfactory. My experience indicates that the villi frequently adhere; buried nests of columnar cells are found, just as in gonorrhœal infection. There is perhaps a tendency to less cellular infiltration. Plasma cells are not so evident. If we may judge from the present study, however, it is extremely difficult to make a certain diagnosis of streptococcic hydrosalpinx or pyosalpinx from the histological evidence alone.

### C. TUBERCULOUS SALPINGITIS (EXCLUSIVE OF GENERALIZED TUBERCULOUS PERITONITIS)

Tuberculous tubes, in the absence of generalized tuberculous peritonitis, were encountered in 5 per cent of these patients.

Not once was tuberculosis diagnosed in the operating room, although several times suspected and looked for. Careful postoperative scrutiny in the laboratory revealed gross tuberculosis in less than one-half of these patients; in 3 an appearance suggestive of tuberculosis was confirmed by the microscope.

Nearly all of these tubes were held by dense adhesions; in only a few cases were they comparatively free. Many of the adhesions could not be separated by blunt dissection and were firmly resistant even on cutting.

In general the gross pathology was similar to severe recurrent gonorrhœal salpingitis. Pallor was sometimes a distinctive feature. The tubes were all considerably enlarged and usually much indurated. Pus tubes of enormous size and tubes with extensive calcification, as described by Williams[1] and others, were not encountered.

The fimbriated extremities of the tubes were adherent or occluded in two-thirds of the cases; caseous material could be expressed from some of the tubes which remained open. Experience with this small group of patients indicates that occlusion of the fimbriæ is frequent, but distinctly less usual than in gonococcus infections of corresponding severity.

The opened tubes revealed that thickening was chiefly due to hyperplasia of the mucosa. The tube lumen was often tortuous, partly obstructed or obliterated. Gross tubercles and ulcerations, although present, were not observed in this series so numerously as in Williams' cases.

The chief histological features were adhesions between the hyperplastic folds of mucosa, great numbers of giant cells, and numerous tubercles. The muscle layers and serosa were seldom involved.

### CONCLUSIONS

1. From the clinical history, examination of the external genitalia, and evidence obtained at operation, together with laboratory study of the tubes in this series of nearly 300 patients, it has been possible to determine that gonococcal infection was responsible for the pathological changes in over 70 per cent of the cases. Approximately 10 per cent more were thought to have been primarily infected with the gonococcus, but this could not be determined with certainty.

2. In somewhat more than 15 per cent of these patients the tubal pathology appears to have been entirely due to other pus-producing bacteria, notably various types of streptococci.

3. Tuberculous tubes, in the absence of generalized tuberculous peritonitis, were encountered in 5 per cent of the cases.

4. Bacillus coli is particularly frequent in tubo-ovarian abscesses of large size. As a primary cause of salpingitis neither the colon bacillus nor the staphylococcus appears to be of notable importance.

5. It has almost never been possible to obtain gonococci in cultures from thoroughly ground fallopian tubes removed from patients who have been free from fever and leucocytosis for a period of more than 10 days or 2 weeks. The fallopian tube appears, therefore, not to be a focus for chronic gonorrhœal infection. Persistently active gonorrhœa of the tubes is evidently ascribable either to recurrence of infection from without or repeated invasion of bacteria from the chronically infected lower genital tract.

6. Tubal infections with various types of streptococci yielded pathological evidence of an active inflammatory process long subsequent to the introduction of infection, and streptococci were occasionally isolated many

[1] Williams, J. Whitridge. Tuberculosis of the female generative organs. Johns Hopkins Hosp. Reports, 1893, iii, 85.

months, or even years, after the acute process had subsided.

7. Gonorrhœal pelvic infection primarily involves the tubes, with resultant thickening, induration, closure of the fimbriated ends, and pelvic adhesions which are amenable to separation by blunt dissection. Microscopically, the folds of the mucosa are found adherent, pockets of gland-like columnar epithelium extend deeply into the wall of the tube, blood vessels are numerous, and plasma cells are characteristic.

8. If the patient can be early isolated from the source of her infection, a single attack of gonorrhœal salpingitis is usually borne without protracted clinical symptoms or severe pathological results. Greatly thickened tubes are most often associated with repeated exposures.

9. Implicit reliance should not be placed upon hæmatosalpinx as dependable evidence of tubal gestation. Hæmorrhage may occur in greatly thickened gonorrhœal tubes.

10. Salpingitis nodosa, although most frequently of gonorrhœal origin, may be due to one of many causes, either inflammatory or non-inflammatory; the microscope best explains the etiology of any doubtful case.

11. In streptococcus infection tubal involvement is usually but a part of the picture. Perisalpingitis is the most frequent type of tubal lesion. Even though there be an extensive salpingitis, the fimbriated extremities will very likely remain open; the mucous membrane folds, or "villi," of such tubes show few adhesions. On the other hand, with the less common occurrence of occluded fimbriæ and accumulated fluid within the tube, adhesions are present between the villi and there are nests of columnar cells in the tube wall; differentiation from the gonorrhœal tube is then difficult.

12. Tuberculosis is very likely to be overlooked if routine histological preparations are not made. When limited to the pelvic organs it is difficult to establish a diagnosis from the gross appearance alone. Unusually resistant adhesions suggest tuberculous or streptococcus infection.

13. Somewhat similar operative measures appear indicated in streptococcus and in tuberculous salpingitis. In both diseases infection is not usually confined to the tubes; in both, viable bacteria are often still present in the tissues at the time of operation and there is danger of chronic-postoperative infection of the ovaries. Particularly in regard to extirpation of the ovaries, more radical surgery appears indicated than in gonorrhœal infections of corresponding severity.

14. The results of this work again direct attention to the dangers of uterine instrumentation. Nearly all streptococcus infections in this series were traceable to instrumental abortion or subsequent intra-uterine manipulation; some tubal infections recurred after curettage; tent dilatation was followed by streptococcic pelvic abscess. It would appear that the normal uterus and fallopian tubes are comparable with an unopened tube of culture media; passage of instruments through the bacterial barrier of the internal os is analogous to removal of the cotton plug, and nature is not always able successfully to combat infection before serious lesions have resulted. This is particularly true if infection which has been previously introduced is stirred up through subsequent instrumentation.

# THE TREATMENT OF PYELITIS[1]

By HERMAN L. KRETSCHMER, M.D., F.A.C.S., Chicago

THIS paper is based upon a study of 200 cases of renal infection. Lesions of the kidney and lower urinary tract of a definite surgical nature, such as renal tumor, stone and tuberculosis, stricture and stone of the ureter, infections of the kidney secondary to hypertrophy and carcinoma of the prostate, carcinoma and calculi of the bladder, and strictures of the urethra are not included. The series, therefore, includes cases that are usually designated as pyelitis or pyelonephritis.

## CLASSIFICATION

The 200 cases may be divided into the following clinical groups: pyelitis of infancy and childhood, pyelitis of pregnancy, pyelitis of matrimony, pyelitis following surgical operations, and cases of simple pyelitis.

Colon pyelitis occuring in newly married women has been termed by Wildbolz (1) "defloration pyelitis." This type of colon infection has also been described by Rosving (2), Sippel (3), and doubtless others. In some of these cases there may or may not be a coexisting involvement of the bladder. It is believed that tears of the hymen serve as atria through which the colon bacilli gain entrance.

In this series there occurred 3 cases that belong to this group or classification.

## PREDISPOSING FACTORS

In this group of cases, careful search was made for the presence of lesions of other organs which might in some way have been factors in predisposing to the occurrence of kidney infections or which might perhaps have been instrumental in causing relapses or in some way have contributed to the failure of treatment.

Early in this work I was impressed by the fact that many of the patients had lesions of the gastro-intestinal tract. These were chiefly bowel lesions, and, of these, constipation headed the list. Thirty per cent of the patients gave a history of constipation of varying degree, for which laxatives and purgatives were used, in some instances, almost to abuse. In a small number of instances, the patients suffered from lesions of the rectum such as hæmorrhoids, and from lesions of the anus, such as fissures and fistulæ; these may undoubtedly have been factors in producing colon bacillus infections and must be taken into consideration in each case when the general plan of treatment is outlined.

Lesions of the male genital tract received due consideration. The presence of infection in the prostate and seminal vesicles was established by rectal examination, and by examination of the strippings obtained from the prostate and seminal vesicles for the presence both of pus and of micro-organisms. In several cases in which we were able to clear up the kidney infection, the patients were sent back to the family physician who was instructed to continue treating the prostate and seminal vesicles by the usual methods. In those instances in which this part of the treatment was not carried out, there were recurrences of the kidney infection. On the other hand, when the infections in the prostate and seminal vesicles were finally cleared up, the kidneys remained free of infection; hence it has been routine in treating our cases of pyelitis in the male to direct the treatment not only to the kidney but also to the prostate and seminal vesicles whenever they showed the presence of infection, recent or remote. Of the 78 male patients whom we have had under observation and treatment 31, or 39.7 per cent, had infections of the prostate, the seminal vesicles, or both.

*Age.* Renal infections may occur at any time of life although the largest number of cases that come under observation are seen in adults. Recent observations show that infants and children often suffer from pyelitis. No doubt many of the cases of cystitis in infants and children are in reality cases of pyelitis, in substantiation of which assertion mention should be made of a recent publication on colon bacillus infection of the urinary tract

[1] Read before the Evanston Branch of the Chicago Medical Society, Evanston, Illinois, February 27, 1921

in infants and children in which it was shown that all the cases were pyelitis, cystitis pure and simple being strikingly absent. (4)

In the present series there were 24 cases of pyelitis in infants and children between the ages of 7 months and 10½ years. The youngest patient treated was 7 months old and the oldest 75 years old.

TABLE OF AGES

| | | |
|---|---|---|
| 7 months | to 10 years | 24 |
| 11 years | to 20 years | 4 |
| 21 | to 30 years | 42 |
| 31 | to 40 years | 51 |
| 41 | to 50 years | 26 |
| 51 | to 60 years | 24 |
| 61 | to 70 years | 14 |
| 71 | to 80 years | 5 |
| Age not stated | | 10 |

From the foregoing table it will be seen that the largest number of cases, 25.5 per cent, occurred between the ages of 31 and 40.

*Sex.* Formerly it was believed that renal infections were rare in women. The perfection of modern diagnostic instruments and the recent intensive study that has been devoted to this topic have completely disproved this old view. Indeed, if one takes into consideration certain renal infections which occur only in women, such as pyelitis occurring during and after pregnancy, the number of cases of pyelitis in girl babies, the association of renal infections with lesions of the female generative organs, and the onset of renal infections after extensive gynecological operations, one may safely say that renal infections occur more frequently in women than in men. An analysis of the series showed the following: males, 39 per cent; females 61 per cent. Thus it will be seen that this condition occurs much more frequently in women than it does in men. These figures are in accord with the views generally held that pyelitis occurs much more frequently in women than in men.

BACTERIOLOGY

The statement is very often made that colon bacillus infection of the kidney is the infection most frequently seen clinically. This statement is borne out by an analysis of the bacteriology of these 200 cases. Colon bacilli were present in 132 cases; staphylococci in 28 cases; streptococci in 1 case; colon bacilli and staphylococci in 10 cases; streptococci and staphylococci in 2 cases; and in 27 cases the cultures were not stated.

With reference to the relative frequency regarding the location of the infection, it may be stated that in this series 99 cases showed positive cultures from both the right and the left sides; in 32 cases, positive cultures were obtained from the right kidney only; and in 17, from the left kidney only; and in 21 cases the bladder and right and left kidneys showed sterile cultures although pus was demonstrated microscopically in these cases. Therefore, these 21 cases should be added to the 99 bilateral cases previously mentioned, bringing the total number of bilateral cases up to 120. In 6 cases the bacteriology, as previously mentioned, was not stated and in 25 cases cultures of the bladder only were given.

Many of the cases in which the cultures were recorded as sterile were seen in the early part of the work before definite routine procedure was established; therefore it can readily be understood that at present the reports of sterile cultures are decidedly unsatisfactory. When the urine shows the presence of pus and sterile cultures, the urine is centrifuged and stained for organisms. On many occasions the urine has shown the presence of bacteria upon stain while the cultures have remained sterile.

These cases are treated by pelvic lavage until the urine is free of pus, the report of sterile cultures not deterring us in any way from using this method of treatment. Needless to add that in this type of case guinea-pigs are inoculated in order to exclude the possibility of renal tuberculosis.

CYSTOSCOPIC DATA

More or less accurate cystoscopic data were available in 177 of the 200 cases, but in 23 cases the cystoscopic records were incomplete. Of the 177 cases in which the findings were recorded, pathological changes were seen in 128 of the cases. Some of the publications on this subject stated that the bladder was negative in a large number of instances. Thus, Geisinger (5) stated that in 40 per cent of his cases the bladder pictures were absolutely negative. In our series normal bladders were seen in only 49 cases, or about 25 per cent.

These figures agree with those of Thomas (6) who reported normal bladders in 25 per cent of his cases. From these figures it is evident that careful cystoscopic examinations showed changes in the bladder in about 75 per cent of the cases. These changes varied in intensity from a slight amount of hyperæmia around the internal urethral orifice to a severe generalized cystitis. In some cases there were irregularities of the sphincter, œdema or congestion of the trigonum, and flakes of pus adhering to the bladder wall. In one case the bladder itself was normal but the ureters were dilated. In one case a small papilloma of the bladder was found and was considered as an incidental finding, having produced no symptoms and being no larger than a small pea. The general impression has been that in cases of pyelitis the bladder is normal. This has not been my experience. It has generally been supposed that the bladder is resistant to infection. This is supposed to account for the rare presence of cystitis in pyelitis; but, while this may be true, the evidence obtained does not appear to substantiate the belief that cystitis is uncommon in cases of pyelitis.

*Pyelography.* In a certain number of cases pyelography was carried out, the pyelograms obtained showing the usual picture of infection. Pyelography was not carried out as a routine unless there seemed to be some special indication for so doing. Pyelograms in several instances have helped to differentiate between a simple pyelitis and a surgical condition of the kidney which might have been mistaken for pyelitis and treated as such. In this way I have been spared the embarrassment of lavaging patients whose condition called for surgical treatment.

### SYMPTOMS

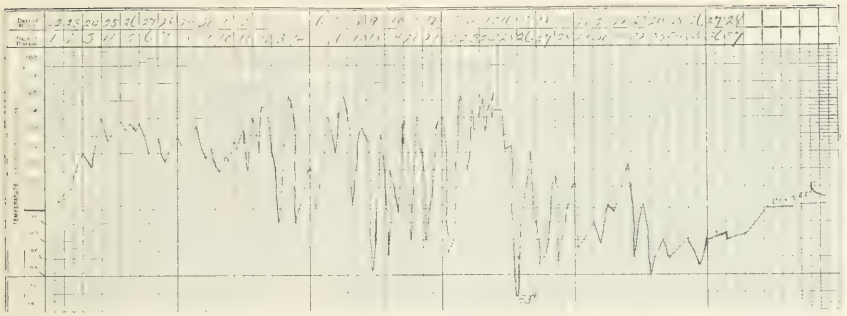
An analysis of the more prominent symptoms showed that bladder distress was the most common complaint; of the bladder symptoms, frequency of urination headed the list. Frequency of urination was present in 66½ per cent of the cases; burning on urination was noted in 37½ per cent; painful urination in 30½ per cent; in 32½ per cent of the cases the patients noted turbidity of the urine; in 24 per cent of the cases, patients complained of blood in the urine which was generally described as not being very severe; urgency was present in 8 per cent of the cases; incontinence in 5 per cent; difficulty of urination in 9½ per cent; nausea and vomiting in 11½ per cent; nausea alone in 2½ per cent; vomiting alone in 2½ per cent; sweats in 9½ per cent; chills in 23 per cent. In 37½ per cent of the cases a definite history of fever was obtained. The amount of fever varied, especially in some of the cases associated with pregnancy in which the fever was unusally high and was associated with a very severe drop in temperature.

The cases of pyelitis of pregnancy appeared to be more severely and more acutely ill than the ordinary cases. Not infrequently the patients had a very severe pallor and there was profound prostration. The greatest excursions in the temperature were likewise seen in the cases of pyelitis of pregnancy (see chart).

### DIAGNOSIS

The diagnosis of infection of the renal pelvis is not a very difficult one. The symptoms in the acute cases, as well as in some of the chronic cases, may be confusing and, as is evident from a review of this series of cases, colon pyelitis, acute and chronic, has been mistaken for a variety of diseases. It would appear from a review of these cases that the causes for overlooking renal infection are due to the fact that frequently a symptomatic diagnosis is made without a careful examination of the urine. A provisional diagnosis may be ventured in a large number of cases if pus, bacteria, and occasionally a few red blood cells in the urine are associated with the symptoms. In the group operated upon as cases of acute appendicitis, this error might have been avoided had a catheterized bladder specimen been examined.

The final definite diagnosis of renal infection must, of course, be based upon an examination of the urine obtained by the ureteral catheter, and this means that the patient must be subjected to a cystoscopic examination. The first step, therefore, in the diagnosis is to demonstrate the presence of pus and bacteria in the urine. The second step is to determine the origin of the abnormal elements found, whether renal or vesical.



Illustrating temperature curve in case of pyelitis of pregnancy.

After having determined the source of the pus, whether from the right side, the left side, or from both sides, the next problem is concerned with a differentiation of the various kidney lesions which are associated with the presence of pus and bacteria. This must necessarily exclude lesions of the ureter, such as strictures and stone, stone in the kidney, renal tuberculosis, tumor, and hydronephrosis.

The smallest source of error has been in cases in which the pus has been established as renal in origin, this resulting in the belief that in instances in which patients are subjected to a routine urological examination, the percentage of error in diagnosis is relatively small. The large number of cases in which either the diagnosis was not made or a wrong diagnosis was made, were the cases that were not carefully studied, and it would appear that the largest source of error was due to the fact that careful examinations of the urine had not been made.

With a good roentgen-ray technique, stone in the kidney and ureter can be excluded. With plates of good quality and careful reading, the percentage of stones overlooked is small. However, in a certain number of cases stones have been overlooked for one or several of the above-mentioned reasons.

The presence of renal tuberculosis often may be masked by the presence of colon bacilli and such cases are often treated by pelvic lavage. This, of course, would occur in cases of renal tuberculosis early in their course, that is, at a time before there is involvement of the bladder. In the series presented here, there were several instances in which a provisional diagnosis of colon bacillus infection was made because of the absence of bladder evidence of tuberculosis. Very diligent search for the presence of tubercle bacilli in the direct smear, and when this was negative, repeated guinea-pig inoculations have prevented wrong diagnoses.

Stricture of the ureter, large hydronephroses and renal tumor can be differentiated by the pyelogram.

An incorrect diagnosis is made in a great number of patients suffering from pyelitis as is evidenced by a review of this series of cases. The diagnoses have varied. Many of the patients were diagnosed as surgical cases, having been operated upon for some supposed surgical condition without obtaining relief from these symptoms.

### PREVIOUS OPERATIONS

Of more than passing interest was the fact that 89, or 44½ per cent, of the patients gave a history of having had some sort of surgical operation. The patients who gave a history of having been operated upon may be divided into four groups.

*Group* 1. This group represents the patients who were operated upon on account of urinary symptoms but who were not relieved of their symptoms. This fact alone would indicate that the presence of pyelitis at the time of

operation or before operation must have been overlooked, the inference being that this was due to insufficient study of the cases. In this group 13 patients had been operated upon, the operations having been as follows: hysterectomy and perineal repair (one patient); appendectomy and operation for duodenal adhesions (one patient); appendectomy, right ovariectomy, salpingectomy, and excision of left ovary and tube (one patient); left tube and ovary removed (one patient); right nephrectomy (one patient); gall-bladder and appendix removed (one patient); abortion (one patient); curettage (one patient); right kidney fixed (one patient); left nephrectomy (one patient); perineorhaphy and ventral suspension of uterus (one patient); appendectomy (two patients).

*Group 2.* The patients in this group exhibited urinary symptoms for the first time after some surgical procedure had been instituted. Assuming this to be true on account of what occurs in some of the so-called postoperative cases of pyelitis, the explanation may be summed up thus: when sufficient urinary study and data prior to operation are not at hand it is within the bounds of probability that the condition known as post-operative pyelitis is nothing else than an exacerbation of a pyelitis that was latent. Nevertheless, in this group there are cases that may be called genuine instances of postoperative pyelitis, the symptoms beginning with retention of urine necessitating catheterization. The operations after which symptons of pyelitis developed, were as follows: ectopic pregnancy (one patient); hæmorrhoidectomy (two patients); appendectomy (two patients); meatotomy (one patient); operation for hernia (one patient); right salpingo-oophorectomy (one patient); left nephrectomy (one patient); hysterectomy (one patient); perineorrhaphy (one patient).

*Group 3.* This group lists 65 cases that had been operated upon many years before they came under observation. A clear conception of the history of each case was sought in an endeavor to establish a connection between the operation and the development of the symptoms of pyelitis. Appended is a list of the operations which had been performed in this group:

| | |
|---|---|
| 17 on the vagina | 2 on the bladder |
| 16 appendectomies | 2 for goiter |
| 15 tonsillectomies | 2 abortions |
| 10 on the rectum | 2 for fibroids |
| 8 on the ovary | 1 on the ureter |
| 4 on the gall-bladder | 1 cæsarean section |
| 4 for adenoids | 1 urethral stricture |
| 4 panhysterectomies | 1 for tuberculous glands |
| 3 leg operations | 1 for cyst of the cheek |
| 3 on the eye | 1 epididymectomy |
| 3 for hernia | 1 on the bowel |

1 for tumor of the breast

*Group 4.* In 7 cases, or 3½ per cent, kidney operations had been done; nephropexy (one case); partial resection of the kidney 35 years before (one case); perinephritic abscess drained (one case); nephrectomy (4 cases). Subsequent infection occurred in the remaining kidney in the nephrectomized cases, on account of which there was little choice in the matter of treatment. All 4 cases responded to pelvic lavage. It would be well to remark here that when treatment other than surgical is offered this class of patients, gratitude is expressed. Although in 2 of these cases a rather well-developed hydronephrosis was present, pelvic lavage was the only treatment which could be considered. In each of these cases, when discharged from the hospital, the urine was sterile and free of pus.

### TREATMENT

In cases of acute colon bacillus pyelitis, instrumental or local treatment was not resorted to. The one exception to this rule was the acute pyelitis or pyelonephrosis which occurs during pregnancy. Although this group of patients was given the benefit of internal treatment before pelvic lavage was instituted, our experience taught us that such cases do not respond to internal treatment, hence internal treatment was not continued beyond the point of safety.

The treatment of the chronic cases of pyelitis may be considered under the following heads: (1) vaccine therapy, (2) medical treatment, and (3) pelvic lavage.

Many of the cases had been through thorough and long courses of vaccine treatment, both stock and autogenous, prior to coming under observation, with negative results. Early in this work the vaccines were used in conjunction with other forms of treatment, but it soon became evident that they were not

of great value in carrying out the treatment, hence their use was discontinued. In none of the cases was the vaccine entirely relied upon, this method being used in conjunction with internal and local treatment. Since discontinuing the use of vaccines, the results obtained have been just as satisfactory as they were when both vaccines and lavage were used; hence, at present the use of vaccines does not enter into the routine treatment.

*Internal treatment.* Various drugs have been used and recommended, but we rely chiefly on the use of alkalies, acids, and urotropin. These are administered for periods of a week. We usually commence with the internal administration of soda bicarbonate in doses of a teaspoonful in a full glass of water, three times a day. Occasionally there are patients who have been unable to take soda bicarbonate for various reasons and in such cases resort to the use of other drugs, such as citrate of potash or citrate of soda. Enough of the drug is given to render the urine distinctly alkaline to litmus and the patients are instructed to test the reaction of their urine several times a day. After the patient has been on this regimen for a week, the alkalies are discontinued and urotropin is given. As a rule, patients are advised to take 10 grains of urotropin in a full glass of water four times a day. During this time they are given 10 grains of acid phosphate of sodium four times a day and are again instructed to test the reaction of the urine. If 40 grains of acid sodium phosphate per day is not enough to render the urine distinctly acid, enough is given to do so. This is done for the well-known reason that urotropin acts best in an acid media. Other drugs, such as benzoic acid, may be used.

Salol is one of the drugs that has been highly recommended and one I have occasionally used, but it should be stated in all fairness that it does not possess advantages over other forms of internal treatment.

In the acute cases of pyelitis, it may be stated that internal treatment had a certain degree of value, since these cases in our series were treated only internally and under the regimen just outlined. However, it is a well-known fact that many cases of colon bacillus pyelitis get well without medical aid, hence the value of these drugs must remain questionable. Despite the fact that the internal administration of drugs was employed as a routine, their value has seemed somewhat doubtful.

*Pelvic lavage.* Of the various methods of treatment at our command, undoubtedly the one that heads the list, so far as efficiency is concerned, is pelvic lavage. The question has been raised whether the desired results are produced by pelvic lavage or by instrumentation, namely ureteral catheterization. At times one sees that after a single ureteral catheterization for diagnostic purposes in patients who have a well marked infection of the renal pelves, the pyuria disappears as does the infection. This clinical observation is not a new one; it has been noted by various observers, and has been considered the strong point of argument for those who object to pelvic lavage. While it is true that occasionally these infections clear up after a single cystoscopy and ureteral catheterization, it is my opinion that this is not the only factor or that too much importance, as a therapeutic measure, should not be attached to it. These arguments may be met with the statement that in some of these cases of colon pyelitis that require a large number of instillations to obtain the desired result, the repeated passage of ureteral catheters do not render the urine free of pus and bacteria.

Various drugs have been recommended for use in pelvic lavage. Koll (7) has obtained very gratifying results by employing aluminum acetate. Recently mercurochrome has been suggested (8). The one group of agents, however, which has received the widest favor contains the drugs of the silver group. Of these, organic silver preparations, such as collargol, argyrol, cargentos, etc., have received general favor. In this series of cases I have used but one drug, namely, silver nitrate, for in the early part of this work silver nitrate was used, and because of the extremely gratifying results obtained, its use has been continued. It is not the purport of this paper to assert that silver nitrate is a specific or that it is the only drug which may or can be used. However, personal experience has shown that

it is an extremely valuable and efficacious remedy in the treatment of pyelitis.

The amount of silver nitrate used should be governed by each individual patient and depends upon the size of the renal pelvis. In the average case from 8 to 10 cubic centimeters were used. In cases in which a slight degree of dilatation of the pelvis is present, it stands to reason that larger amounts can be used. A precautionary measure to follow, and one to which we have adhered, is not to overdistend the kidney pelvis, a measure which precludes the causing of pain and renal colic.

If possible, pelvic lavage is carried out twice a week, or every five days, the treatment being continued until the urine is sterile and free of pus.

In treating cases of pyelitis in childhood, it is advisable to use a solution of silver nitrate of ½ per cent strength, the amounts used varying from 1 to 3½ cubic centimeters, and depending in part upon the size and age of the child. In adults a 2 per cent solution has been employed as a routine. This may appear to some to be rather a strong solution of silver nitrate to inject into the kidney pelvis, yet Geraghty (9) has recommended silver nitrate of the strength of 5 per cent. I have never employed solutions stronger than 2 per cent since the necessity has never presented itself. On the other hand, much weaker solutions have been recommended by some authorities.

In discussing the results it may not be amiss to consider briefly the results sought in establishing a cure. Of this series no case was considered as cured unless the urine was free of pus and the cultures remained sterile, three negative cultures being the routine. The subjective symptoms were the first to disappear and the pus next, the latter in many instances disappearing before the urine was finally free of organisms; but no case was pronounced cured because the subjective symptoms were relieved.

In analyzing this series of cases with reference to ultimate results, it was necessary to divide the cases into the following groups: (1) cases that died, (2) cases that failed to complete the treatment, (3) cases that were cured and (4) cases that were failures.

*Group 1.* In this series of renal infections 2 cases terminated fatally, the cause of death in each instance not being due to the pyelitis alone but to other co-existing pathological conditions. These 2 cases may briefly be mentioned.

One was a patient in a psychopathic hospital whom I saw in consultation 4 days before she died. The patient was in a very critical condition. The diagnosis was established by cystoscopy and ureteral catheterization; an instillation of silver nitrate was given but not with any hope of effecting a cure. The patient died as a result of her psychosis, the pyelitis doubtless being terminal.

The second patient suffered from a pyelitis which began in the puerperium. At the time I saw her she was suffering with severe chills, fever and sweats, associated with colon bacilli in the urine. Because colon bacilli were in the urine, it was thought advisable by her physicians to catheterize the ureters in order to differentiate between a puerperal sepsis and a severe colon pyelitis. Colon bacilli being present both in the right and left kidneys, silver nitrate was injected after the first examination and a second treatment was given a few days later. It was apparent that the patient suffered from a severe general sepsis and that the pyelitis was a secondary consideration. The autopsy showed thrombophlebitis of the iliac and femoral veins, abscess of the right ovary, acute nephritis, and pneumonia.

*Group 2.* This group comprises 89 cases. No cure was obtained for various reasons. Some of the patients were seen out of town, or were so situated that pelvic lavage could not be carried out. Others refused to accept this form of treatment. In the remainder of this group the treatment was instituted, but for various reasons the patients failed to co-operate or to return for further lavage. It may be possible that of this number a certain percentage have gone on to a cure, but proof of this is lacking. Lack of co-operation on the part of the patient is unfortunate, for the reason that it might give an unfair aspect to the efficacy of this treatment.

*Group 3.* In this group were 97 patients in whom urine, sterile and free of pus, was obtained before they were discharged from the hospital. Of this number, 85 were cured by means of pelvic lavage, being treated by injections of silver nitrate as discussed under the heading of Treatment. The number of injections necessary to obtain a cure were as follows:

| | Cases |
|---|---|
| One injection | 41 |
| Two injections | 11 |
| Three injections | 8 |
| Four injections | 5 |
| Five injections | 2 |
| Six injections | 1 |
| Seven injections | 1 |
| Eight injections | 2 |
| Nine injections | 1 |
| Ten injections | 1 |
| Sixteen injections | 1 |
| Number not stated | 11 |

The total number of cases treated by pelvic lavage was 128 and of this number 85 were discharged from the hospital with the urine sterile and free of pus, making the percentage of cases cured 66.4 per cent.

In 12 cases sterile urines were obtained without the use of routine lavage. These patients were cystoscoped and the ureters catheterized for purposes of diagnosis. Although, as a result of the examination, a diagnosis of pyelitis was made, subsequent bladder specimens showed urine sterile and free of pus.

*Group 4.* Twelve cases treated by pelvic lavage were not cured at the time of dismissal from the hospital. Analyzing these 12 cases we find the following interesting data: Two of the patients suffered from organic disease of the central nervous system. Both had so-called spinal cord bladders with retention of urine. In one instance the spinal cord disease was syphilitic in origin and in the other the changes in the spinal cord were secondary to pernicious anæmia. Three of the patients had large hydronephroses. Three patients suffered from chronic infections in the prostate and seminal vesicles. In two patients no apparent cause for failure could be ascertained. One patient had a hydronephrosis and diabetes. The remaining patient suffered from chronic morphinism.

### ACCESSORY TREATMENT

As the work progressed it became evident that our attention must not be focused on the urinary tract alone. It soon became evident, especially in the cases that were rebellious to this form of treatment, that there were factors outside the urinary tract that were responsible, in a measure, for the failure of this treatment. In some of the cases these accessory factors were not and could not be recognized. However, in a large number of instances, additional factors were found and treated, and, as a result, progress was more rapidly made; hence, in treating these cases we do not look at them as strictly urological cases.

It is a well-recognized fact that lesions of the gastro-intestinal tract produce infections of the urinary tract. These lesions may be of two types, either so-called chronic constipation or other bowel conditions such as colitis. In eliciting the histories of these cases, one is surprised to find how frequently the patients give a history of various sorts of bowel distress. It has been our custom, upon establishing the fact that the patient had some sort of gastro-intestinal disease, to refer the case to the gastro-enterologist for appropriate gastro-enteric treatment, and we have found that this has materially hastened the patient's response to this form of treatment.

Various rectal conditions undoubtedly play a rôle in keeping up colon bacillus infections of the kidney. These rectal conditions, such as fistulæ, fissures and hæmorrhoids call for appropriate treatment.

As a part of the routine examination, careful attention must be directed to the presence of infection in the prostate and seminal vesicles. It is not uncommon to find that many of these patients suffer from co-existing infection either in the prostate or seminal vesicles, or in both; most often in both. We believe that it is just as important to treat these co-existing infections as it is to treat the pyelitis; and in some of the cases in which we have failed to obtain cures, the response to treatment has been more rapid after instituting proper treatment for the prostate and seminal vesicles. In some of the cases in which the patients have had relapses, the relapses were attributed to the co-existence of infection in the prostate and vesicles, because after treatment was directed toward the eradication of the foci of infection, the kidney condition rapidly cleared up.

Attention has likewise been directed toward the female genital organs and the patients have been directed to take douches either of soda bicarbonate or potassium permanganate solution. Certain lesions of the pelvic organs in women are doubtless responsible for

the presence of pyelitis and these, needless to say, call for appropriate surgical treatment.

In this series 5 of the cases showed lesions in the pelvic organs. The following lesions were found: Polyp of the uterus, cystocele and rectocele, polypoid growth on the left side of cervical stump; and fibroid of the uterus. Obviously, to treat a patient for pyelitis by means of pelvic lavage and to overlook the presence of a large fibroid can only result in bringing this form of treatment into disrepute.

In this series of cases there were 6 in which pelvic lavage was the only form of treatment advisable because the patients had only one kidney and this kidney showed the presence of infection, the opposite kidney having been removed previously for a surgical condition. In one case the kidney was removed because of hæmorrhage following the removal of a renal stone; one because of urinary symptoms similar to the present trouble; one for solitary cyst of the kidney; one for pyonephrosis; one for intermittent hydronephrosis; and in one case no reason was given for removal of the kidney.

In this series of cases, 14 occurred during pregnancy or the puerperium. The methods of treatment which have been advised in the treatment of this condition in pregnancy are: (1) to empty the uterus; (2) surgical removal of the kidney; (3) pelvic lavage.

The first two methods of treatment do not meet with my approval. In the majority of these cases, patients were advised to have the uterus emptied and in one instance the advice was that the infected kidney should be operated upon. The fact that we acted against this advice and that the patients were delivered of healthy children lends strong support to the use of pelvic lavage in the treatment of a pyelitis of pregnancy. When these patients were discharged from the hospital, 8 had sterile cultures and in 2 the kidneys were sterile but the bladder was positive.

While the number of cases of pyelitis of pregnancy is small, still it is quite apparent that the results justify giving this form of treatment an opportunity. If, after conscientious and prolonged trial of this method, the desired results cannot be obtained, and provided the symptoms persist, then either of the above surgical interventions may be considered.

The treatment of pyelitis of infancy and childhood has been considered in a separate paper (4).

### SELECTION OF CASES FOR TREATMENT

This series of cases represents cases of so-called simple pyelitis that seemed suitable for the method of treatment described. Naturally, in selecting cases for such treatment, organic lesions of the urinary tract, which call for surgical treatment, should be excluded. It is well known that colon bacillus pyelitis may mask the presence of a renal tuberculosis and wrongly treating it by pelvic lavage is a possibility that must always be entertained. If an error is made in diagnosis, the desired result cannot be obtained and the method is discredited. The importance, therefore, of eliminating tuberculosis is obvious, and this we have done by diligent search for the tubercle bacillus in direct smears and by means of guinea-pig inoculations.

The presence of stone in the ureter and stone in the kidney has been excluded by means of the roentgen-ray. In two instances the X-rays were negative and it was assumed that the patients had a simple pyelitis. Subsequent passage of stones by the patients demonstrated the error in diagnosis. The presence of stricture of the ureter calls for appropriate treatment for the stricture.

### CONCLUSIONS

1. Pelvic lavage with silver nitrate is an efficient, simple method for treating infections in the renal pelvis.

2. In this series of cases 66.4 per cent of the patients treated were finally discharged with urine sterile and free of pus.

3. In selecting cases for treatment, lesions of the urinary tract of a surgical nature must be excluded.

4. Lesions of the abdominal viscera which may be factors in contributing to relapses or rendering this treatment inefficient must be recognized and subjected to appropriate treatment.

5. Special stress must be laid upon giving the proper attention to lesions of the gastro-intestinal tract.

6. Lesions of the male and female genital tract must receive appropriate treatment.

7. Careful routine examinations of the urine in all cases of obscure abdominal pain should be made before patients are subjected to surgical operation.

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# THE TREATMENT OF PERIPHERAL NERVE INJURIES[1]

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IN introducing the subject of the surgical treatment of peripheral nerve injuries I must confess to a growing optimism as regards the ability of a damaged nerve to restore itself if happily given the opportunity.

During the winter of 1918–1919, while co-operating with Lieut.-Col. F. H. Mackay, then chief of medicine in the Granville Canadian Special Hospital, Buxton, we had the opportunity of uncovering a series of 112 damaged nerves, 35 for freeing and 77 for suture. Careful records of these were kept, and they form the basis for my remarks this afternoon. The final results of all these cases are not available, as they have since scattered widely, but a sufficiently large number have been followed through to enable one to speak with some degree of assurance. The after-results were recorded by the physicians, not by the operator, whose judgment in these matters may be fallacious.

The final chapter in nerve surgery has not yet been written. Some time must elapse before the publication of reports which commissions are preparing in the various belligerent countries, but in the meantime there has come to be a fair unanimity of view among those best qualified to judge, and we were fortunate in undertaking our series at a time when we could profit by the experience of numerous observers. The teachings of Sir Berkeley Moynihan, Sir Robert Jones, and Sir Harold Stiles were especially helpful.

One need scarcely emphasize the importance of the pre-operative care of these patients; the massage and electrical treatment of paralyzed muscles to prevent degenerative changes, the mobilization of joints fixed or likely to become fixed, and not less important the careful splinting to prevent the paralyzed muscles from becoming stretched by the constant pull of their antagonists.

## INDICATIONS FOR OPERATIVE INTERVENTION

Of the numbers of nerve wounds which were under observation during the period of which I speak, not more than one in four was referred for operation. The great majority, including some which at first suggested complete interruption, recovered without interference.

The problem was to know when to undertake operative measures. These must necessarily be delayed by the presence of sepsis, and by the existence of stiffness of the joints; the former is almost certain to spell failure, and the latter becomes further aggravated during the period of enforced rest following operation. I find that our cases were explored at periods varying from less than 3 months after injury (in one case of severe causalgia) to an interval of slightly over 9 months following the receipt of the wound (disregarding a much delayed operation on a returned prisoner). The average time was 5½ months. There were operated upon during the third month after injury, 1; fourth month after

[1] Read before the Clinical Congress of American College of Surgeons, Montreal, October 14, 1920.

injury, 11; fifth month after injury, 26; sixth month after injury, 40; seventh month after injury, 20; eighth month after injury, 10; ninth month after injury, 2; tenth month after injury, 1; after 2 years, 1. An iodine wash-up was employed as a routine. With the one exception noted no wound was explored before it had been healed for a period of 3 months, and in the series, only two wounds failed to heal by primary union: one curiously enough where operation was delayed for the longest period in the ordinary series, in a patient who went absent without leave immediately after operation and returned with slight infection; the second in a case of sciatic suture where a cyst was found separating the ends of the nerve. I believe that in the rare cases where these cysts are encountered, it is wiser to leave in a 24 hour rubber tissue drain; otherwise no drainage was employed.

We are justified in delaying operative measures if definite and progressive improvement is taking place, but if there is substantial evidence of serious interruption, and signs of recovery are lacking, I believe it is wise to explore with the least possible delay, provided the wound has been healed for upward of 3 months. It must be emphasized that it is impossible to distinguish for certainty by any sign or syndrome whether we are dealing with a transitory or a permanent block.

An operation undertaken by skilled hands can do no harm, will yield information as to the exact nature of the lesion obtainable in no other way, and may result in lasting benefit. The operator must have a thorough knowledge of anatomy; branches will often be conserved by knowing where they are to be expected. Conversely, branches have sometimes been sacrificed where zeal went before knowledge. Ample assistance is a prerequisite. The nerve is best approached by generous incisions through normal tissue above and below the scar, and must be handled with a minimum of trauma. Absolute asepsis should be maintained and thorough hæmostasis. A tourniquet is better dispensed with, if it is possible to do so, as the subsequent oozing is thereby lessened.

NEUROLYSIS

Some observers, including Delagenière, have not been enthusiastic about neurolysis, or nerve freeing. Most of our cases of freeing have given satisfactory and some of them most gratifying results: in one case where the median was involved in a dense scar in the lower axilla, freeing relieved the causalgia from which he was suffering and restored flexion to the index finger and thumb within 5 weeks of operation.

In another instance where the median and ulnar were both involved in dense scar under the pectoralis major, the causalgia was immediately relieved and the circulation in the hand greatly improved; the sensory and motor paralysis disappeared by the end of the ninth week.

One case of interest concerned an individual who had been taken prisoner and had undergone in Germany an operation for suture of the sciatic some 2 years previously with partial success, inasmuch as he had limited voluntary power in the calf muscles. The nerve was cut down upon, and was found throttled in the grasp of a fascial wrap, involving especially the lateral half. When this was removed by careful dissection the nerve had a look of promise about the suture line, and was not further disturbed. Within 7 weeks he had definite voluntary power in the tibialis anticus, with marked increase of power in the flexors, and an obstinate trophic ulcer on the great toe of 2 years' standing had completely healed.

One median nerve, which gave evidence of a complete lesion in the mid forearm, when freed from 2 inches of scar tissue, was found to present two small interstitial neuromata the size of a split pea. Stimulation by weak faradism gave a limited response, and as the nerve otherwise felt soft and uniform the wound was closed. The case markedly improved, and within 5 weeks had a return of power and a marked decrease in the area of analgesia and anæsthesia.

Contrary to expectations a previous ligation of the axillary artery proved no bar to a good result after extensive freeing of the cords of the brachial plexus in what had clinically appeared to be a severe lesion. Within 9

weeks the motor paralysis had almost completely disappeared. In another case presenting a large aneurismal varix of the axillary artery, where I was able to excise the vein and suture the wound in the artery, the cords were firmly matted in scar tissue sufficient to lead to a clinical diagnosis of complete interruption of the ulnar and musculospiral. It was found possible to do a satisfactory freeing, and the patient made a most gratifying recovery, having the return of full function in less than 4 months.

Freeing is justifiable if it restores a nerve that is fairly uniform, soft, and supple, especially if a response is given to weak faradism, but the absence of the latter does not necessarily mean resection and suture. The interstitial neuroma presents a special problem, and each case for and against section must be weighed on its merits. The dictum of Tinel that "a good suture is far better than a bad liberation" is worthy of more than passing notice.

NERVE SUTURE

The recovery after suture is necessarily slower than after freeing, but our results have been on the whole most encouraging. Some if not worthy to be described as perfect fall not far short. One case of suture of the musculospiral, well above the elbow, where the distal end was found greatly diminished in size, was able within 2 months to extend the wrist. This man, with the gratitude of the patient in the scriptures who was contrasted with the remaining nine, hunted me up on my return to Canada 6½ months after the operation, to show me an arm which he proved was in all respects as good as its fellow.

I have seen complete successes in the median, both above and below the elbow. The ulnar nerve is perhaps less satisfactory, especially as regards the return of power in the interossei, but some cases have shown excellent recoveries. One ulnar nerve from which 2 inches were resected immediately above the elbow was examined 72 days after operation by Mackay, who made the following report: "Now has full voluntary power in interossei; this has been a remarkably excellent result in a short time." Another ulnar nerve sutured in the mid forearm had definite voluntary power in the interossei on the sixty-seventh day following operation.

The method of suture we employed is not new. In a recent retrospect of the surgery of the peripheral nerves, I took occasion to say that the advice of the twenty-year-old edition of that most excellent textbook of surgery by Rose and Carless holds true today. I quoted: "Suture is best accomplished by using a domestic sewing needle without cutting edges . . . and the finest chromicized catgut. One or more stitches should pass through the nerve, and the rest merely through the sheath. Absolute asepsis is essential in order to obtain satisfactory results." With the omission of the word chromicized as Mr. Carless has done in later editions, the truth could not be better told.

Fascial wraps were not used. As far as possible the suture line was left in its natural site, i.e., in an intermuscular or subcutaneous plane. The divided ends were freshened to provide healthy fibers, and although in some cases this meant a gap of 3 or 4 inches, *in no case of the series* was it found necessary to resort to nerve grafting. In three cases of injury to the musculospiral nerve at the elbow, it was impossible to find the distal motor nerve (posterior interosseous), and a subsequent tendon transplant was advised, a procedure which gives excellent functional results. Apart from these, end-to-end suture was accomplished in every case, by free exposure of the nerve, by stretching before the bulbs were sectioned, by posture, sometimes by alteration of the course of the nerve to provide a shorter route.

In one ulnar lesion in the mid forearm where it was obvious that the gap would be insurmountable, the freed bulbs were approximated by a stout chromicized catgut suture with the wrist in acute flexion, it being gradually extended during the following fortnight. This man had a convenient tattoo mark on his forearm, representing "Buffalo Bill," and it was noted that the suture was exactly opposite the necktie. After a month the bulbs were again cut down upon, the ends freshened, and approximated with a minimum of trouble. Five weeks later there was marked recovery in sensation and there was slight but definite

power of adduction in the little finger, absolute evidence of regeneration. I believe this procedure to be a sound one and well worthy of employment.

While undue tension is to be avoided, moderate tension does not seem to be a deterrent to regeneration, provided it is not sufficient to tear the suture line apart. In fact in many of our striking successes the operation report comments on the tension of the nerve. On the contrary, jamming of the ends together is undoubtedly a cause of failure. I further believe that every effort should be made to prevent torsion of the nerve.

Some time ago I had a letter from Dr. Gallie of Toronto saying one of our cases had been referred to him, showing remarkable recovery of both median and ulnar nerves. On looking up the records I found he had had an end-to-end suture of both nerves in the upper arm less than 8 months previously, and that at the time of his original injury the brachial artery had been tied. This corresponds with the successful neurolysis case where the axillary artery had been severed.

Some of our cases presented opportunities for what may be termed conservative suturing, and from results obtained I believe this is sometimes justifiable. In the larger trunks, as for instance the sciatic, it may be found that the lesion is confined to one portion of the nerve. In such a case it is simple to split the nerve longitudinally, removing the damaged portion and suturing the ends, leaving the undamaged portion looped upon itself. But this method may also be applicable in a smaller nerve—thus in one instance we uncovered a partial lesion of the median nerve above the elbow in which there was some voluntary flexion in the fingers, but none in the thumb; there was no loss of sensation, rather a hyperalgesia over the median area, and severe causalgia was associated. At operation the nerve was found involved in a very dense scar, and when freed presented a lacerated and irregular appearance in the lateral half, with good fibers in the remainder. Stimulation gave a partial response in the fingers but none in the thumb. One hesitated to sacrifice the part that was functioning, so the nerve was split longitudinally and the ends of the half-nerve sutured after excision of the damaged portion. Mackay's report some 6 weeks later reads: "There is a very marked improvement in this case: flexion is now present in all phalangeal joints; distal phalanx of thumb can be strongly flexed, and index finger flexed at all joints; sensation normal all over hand; atrophy as before: there is much less fibrosis of hand, and patient should get full recovery."

Several of the musculospiral injuries were associated with fractures of the humerus, where the nerve was involved in the callus. The most instructive complication of a fracture was in a patient, who, on receiving a bullet wound through the knee, had fallen, causing a transverse break of the femur in the middle third. He was admitted to us for a complete external popliteal lesion, with the femur well united, but with some 3 inches of overriding. We explored at the level of the bullet wound, to find the nerve intact. Continuing the incision upward, we found that in falling, the femur must have telescoped a further 3 inches to cause a complete division of the nerve some *6 inches* below the fracture line.

Perhaps the most unusual of all our cases was one in which a complete paralysis of the deltoid existed. An X-ray of the shoulder revealed a very small foreign body, just posterior to the surgical neck of the humerus. Mackay suggested that this small fragment had divided the circumflex nerve, and advised exploration. At operation it was found that the fragment had severed the nerve just at the point of its bifurcation. By good fortune the distal ends were secured in the substance of the deltoid and the proximal end was identified coming through the quadrilateral space. The ends were very small and could not be sutured in the established method, but they were anchored together and a measure of continuity restored. On the twenty-ninth day he was found to have voluntary power in the muscle, and within 5 weeks the deltoid had sufficiently recovered to hold the arm at right angles against gravity. The rapidity of the recovery is not to be wondered at when one realizes the short distance the regenerative process once established had to travel.

It may be of interest to refer in passing to a sciatic lesion from which there was considerable causalgia. In cutting down on the nerve one-half was found completely divided and presenting a large proximal bulb. In the remaining half a hard mass was encountered, which proved on section to be true bone, extending over 2 inches along the course of the nerve. This was excised and an end-to-end suture was performed. As every effort to find evidence of a fracture or bony injury was unavailing, one was forced to look upon the process as an unusual example of metaplasia. An X-ray of the specimen, after removal, revealed clearly the curious contour of the newly formed bone.

Time does not permit more than a passing reference to after-treatment; massage and galvanism are probably of value; careful splinting to maintain the paralyzed muscles in relaxation is indispensable. When recovery is sufficiently advanced, re-education by purposeful movements is of prime importance, and the various forms of apparatus so essential at first should be dispensed with at the earliest possible date.

In nerve surgery one must guard against impatience; nerve growth is an extremely deliberate process. One of our patients reported recently with a regenerated musculospiral in whom a tendon transplant was done some 7 months after the nerve was sutured. In our series we saw no results which may be described as phenomenal or which would lead us to think that regeneration in the sutured nerve proceeds in other than an orderly way. As I said at the outset our results have made me optimistic on the subject; nature's healing power never seems more wonderful than when one is permitted to see paralyzed muscles regaining their power, impaired sensation being restored, and trophic changes disappearing in an extremity, following upon the effective restoration of conductivity to a damaged nerve.

# THE DIAGNOSIS OF PERIPHERAL NERVE LESIONS

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THE conclusions which I wish to present in this paper are based on the examination of over 600 cases of peripheral nerve injuries, treated at the Granville Canadian Special Hospital, Buxton, Derbyshire. This hospital was specially instituted for the treatment of nerve lesions, and as all observations were directed toward the purely clinical aspect of the problem, I shall attempt to discuss only the clinical findings and their bearing on diagnosis.

To one whose attention is confined to clinical problems and whose primary objective is to decide on the necessity of operation, I think little opportunity for the study of physiological problems is given, and any conclusion arrived at must necessarily be of little consideration to the physiologist. In the first place, we were dealing with war wounds, often with badly lacerated tissues, and always with men, who withstood the hardships and emotions incident upon war-zone experience for months and years. To attempt physiological investigation in such patients, with their shattered nervous systems and ill-controlled emotions, whose only concern was their early return to Canada, would lead to conclusions, which, I fear, would not be accepted by the physiologist.

On the other hand, the opportunity for clinical investigation has been great and if, in this field, our observations fail to uphold the teachings of former or even contemporary workers, we are, I believe, justified in discarding such tenets from our diagnostic armarium.

Armed with the accepted teachings on nerve phenomena, anatomical and physiological, and confident that all nerve lesions could be placed under one of the several syndromes formulated by the continental writers, we approached the problem with an easy mind, but in a very few months we learned that no such easy classification was possible, and that the general clinical picture offered a surer guide to a correct opinion than any effort to fit the signs of each case into a definite nerve syndrome.

In studying nerve regeneration, whether spontaneous or following nerve suture, we also found that complete adherence to formulated schemes and accepted teachings led us far afield.

Our first problem was to decide whether we were dealing with a complete or partial lesion, and given several examinations, which followed each other at ten-day intervals, and a due regard for the many deceptive factors which invariably arise, this was not always difficult. To decide, however, when dealing with a complete lesion, whether it is due to anatomical or physiological interruption, was a very different matter and I know of no scheme whereby this differentiation can be definitely made, other than by direct observation at operation.

Innumerable signs and phenomena have been recorded to assist in a reasonable forecast as to the possibility of spontaneous regeneration, but unfortunately many, or I may say, most of these have proved fallacious and on this occasion I propose to discuss these signs and the assistance they may have been to us in this work.

Dealing, primarily, with motor phenomena, one is surprised to learn how frequently muscles, which were formerly considered the sole means of certain joint or bone segment movement, may be supplanted in their function by other muscles or tensions, and how often attitude of the limb may lead to erroneous conclusions.

Accepting as our standard of function the movement of a joint segment, there are very few exceptions to the rule that these movements may be substituted by other muscles or tensions, and these exceptions comprise our sole means of differentiating a complete lesion from an incomplete.

In the case of the musculospiral nerve, I believe that inability to extend the terminal

[1] Read before the Clinical Congress of American College of Surgeons, Montreal, October 14, 1926.

phalanx of the thumb is a certain indication of complete loss of function in that nerve. Apparent extension of this phalanx is possible, but in all cases is, I believe, due to the synergic action of the flexors, whereby the segment is primarily flexed under tension, which flexor movement is followed by secondary rebound, simulating weak extension. And this is true of all segments under the control of synergically acting muscles. When voluntary movement is attempted by a paralyzed group of muscles, the antagonistic muscles are overcontracted and the rebound from this overtension simulates movement of the segment in the direction of the paralyzed muscle. If this is understood and guarded against, extension of the distal phalanx of the thumb is never observed in a completely paralyzed musculospiral nerve.

Slight extension of the proximal phalanges of the fingers may be apparent if the hand is allowed to be flexed at the wrist, resulting in undue tension on the extensor tendons, by this time sclerosed and shortened to a degree not possible in health, but this may be guarded against by placing the palm in line with the forearm on a flat table, the fingers being flexed at the metacarpophalangeal joints to a right angle and hanging over the edge. Under these conditions, extension of the finger at the metacarpophalangeal joints is impossible if the musculospiral nerve is completely paralyzed. Extension at the wrist-joint is frequently simulated if the fingers are strongly flexed, thereby setting up tension on the dead extensor tendons of the fingers, which results in passive extension at the wrist.

Adduction and abduction of the hand, at the wrist-joint, is undoubtedly possible in cases of complete musculospiral paralysis, notwithstanding many statements to the contrary. That these movements are affected by the flexor carpi radialis and the flexor carpi ulnaris, respectively, is shown by the noticeable degree of flexion that accompanies them.

In considering the median and ulnar nerves, one must first recognize the close relation between the functions of these structures, particularly in regard to their distribution. There is little doubt that one continually meets with irregularities and overlapping, both in their motor and sensory distribution, and this particularly applies to the innervation of the lumbricals and flexors of the fingers. Quite frequently, one observes full flexion of the middle finger in complete median lesions, which must be explained by partial ulnar supply to the flexor sublimus and, in some cases, ulnar innervation of the flexor profundus to that digit. Flexion of the terminal phalanx of the thumb is sometimes simulated by rebound, following contraction of the extensor longus pollicis.

The only irrefutable sign of complete median lesion is the loss of flexion of the two terminal phalanges of the index finger, which movement cannot be supplemented in absence of median innervation.

We have never encountered any evidence to disprove the innervation of the interossei by the ulnar nerve alone, and as the function of these muscles in health is to adduct and abduct the fingers, to extend the two distal phalanges of all the fingers and, in conjunction with the lumbricals, to flex the proximal phalanges, one would expect that all these functions would be lost in complete lesion of the ulnar nerve. As a matter of fact, extension does take place in the terminal phalanges, probably by contraction of the extensor communis digitorum exerting tension on these distal segments through the paralyzed and lifeless bellies of the dorsal interossei, which now act as connecting fibrous structures only. Lateral movement of the fingers, especially in the index and little fingers, is sometimes observed in complete lesions of the ulnar, but is always combined with simultaneous extensor movement, indicating a supplementary action of the extensor communis digitorum. If the hand is placed on a flat surface and the fingers maintained in line with the palm, lateral movement of the fingers is impossible in complete ulnar lesion.

In injuries of the sciatic nerve, like difficulties are rarely met with. Dorsi-extension of the foot, at the ankle-joint, may occur if the toes are strongly flexed at the same time, thereby exerting tension on the paralyzed extensors of the toes. If this movement is

guarded against, extension of the foot does not occur if the external popliteal is divided, nor can eversion of the foot occur, except when there is some degree of function in the external popliteal nerve.

One must therefore conclude that simple movement of a joint segment does not always indicate integrity of the nerve of supply, while, on the other hand, complete loss of voluntary power, at one or two examinations, may not bespeak complete physiological interruption. This is especially observed in nerves, whose constitution is predominantly motor, such as the musculospiral and the peroneal branch of the external popliteal. In these nerves slight injuries may set up apparently complete paralysis in the muscles supplied, lasting for several weeks and terminating in spontaneous recovery. In such cases, it may be assumed that there is an associated functional paralysis, which tends to perpetuate the original organic disability, and this is given support by the frequent necessity of inaugurating movement by some form of persuasion.

Loss or diminution of the various forms of sensation is generally considered a fair index to the degree of nerve injury, but, in our cases, we found that neither the extent nor degree of disturbed sensation offered a reliable indication of the condition of the nerve. The extent of loss of cutaneous sensibility varied so much in different lesions, proved, later, to be totally interrupted, that we could no longer regard it as unassailable evidence of nerve destruction or integrity. In complete ulnar lesions, the loss might involve the whole anatomical distribution of this nerve, or only the palmar and dorsal surfaces of the little finger, more frequently extending just below the root of this digit. Totally interrupted median lesions, likewise, might show sensory change over the first three fingers and entire median area of the palm, while, in other cases, the loss might be confined to the index finger alone. Complete division of the musculospiral, above the origin of the radial branch, is frequently unaccompanied by cutaneous loss.

This variation in extent of sensory loss applies to all the peripheral nerves and must be explained by overlapping of adjacent nerve terminals or, in some instances, by anastomosis with adjacent nerve trunks.

Careful examination of all forms of cutaneous and deep loss was made, including pain, touch, temperature, pressure, position and vibration sense, and an effort made to map out different zones for each of these forms of sensation. It must, here, be stated that no mechanical gradation of stimulus was made, our technique consisting in the use of a pin for pain, camel's hair brush or cotton wool for touch, and test tubes containing water at 22° C. and 50° C. In cases where the extremity was cold, it was immersed in warm water at about 35° C. before examination was undertaken, as it was found that reliable results could not be obtained in a cold limb.

Schooled in the doctrine of epicritic and protopathic systems of sensory innervation, we endeavored to outline two zones, an inner, where all forms of sensation were lost, and an outer, where only touch and finer discrimination were missing; but invariably failed to satisfy ourselves that such definite line of demarcation could be drawn.

Our first procedure was to outline carefully the area of loss to cotton wool (light tactile sensation), and secondly that of pin prick (pain). With heavy prick one could locate an area, centrally or distally placed as the case might be, of total anæsthesia. Then with moderate prick, a larger area surrounding this and, finally, by very light prick this area could invariably be extended to coincide with the area of anæsthesia to cotton wool, previously mapped out, so that it was theoretically possible to outline various concentric zones, corresponding to the degree of force used in manipulating the pin. Our experience was that the areas of loss to cotton wool and loss to light pin prick were identical, so that we came to rely, for all practical purposes, on the use of light pin prick, while, at the same time our belief in two separate and distinct systems for cutaneous sensation, one, the epicritic, underlying light touch and the other, the protopathic, underlying pain, could not be reconciled with our findings.

Loss to temperature sense, as interpreted from the use of test tubes, containing water at about 50° C. and 22° C., was so variable as

to be of little practical use, but roughly corresponded with the area of loss to light touch and light prick.

Loss of deep sensation, for pressure, vibration and joint movement, generally involved an area much in excess of the cutaneous loss and gave little or no information of value to the clinician.

Variation in the extent of cutaneous loss, from day to day, suggests a partial lesion or a superadded hysterical disability, while constant adherence to the original limits, however limited or extensive, bespeaks a complete physiological lesion.

From a consideration of the electrical reactions, alone, we obtained little information of prognostic value, while from the standpoint of diagnosis, its most useful application was in differentiating functional paralysis. Very slight organic lesions, which began to show regeneration in 3 to 5 months under nutritional treatment, were almost always accompanied by early loss of faradic stimulation, while severe lesions showed loss to faradism throughout the entire period of regeneration, this being the last factor to return. In our experience, return of faradic excitability was invariably preceded by return of voluntary power and frequently by return of "pin-prick" sensation. The type of response to the galvanic stimulus was of considerably more value in diagnosis. The slow, sluggish response, with retarded relaxation, indicated a severe lesion and was the most reliable index to the reaction of degeneration at our disposal.

Polar changes, as evidence of complete reaction of degeneration, were found unreliable and were early discarded for the use of condensor shocks, applied to the galvanic current. For this purpose, use was made of the Lewis Jones condenser, which, in the hands of some workers, appeared to be of value in denoting regeneration, some even basing their prognosis on the number of micro-farads necessary to set up contraction. Here, too, we met with disappointment, as it was found that changes in muscle excitability, as registered by this apparatus, were frequently misleading.

Frequently we have noted improvement in the condition of the muscle under nutritional treatment, as reflected in the number of micro-farads necessary to produce response, advancing from 2.0 micro-farads, at first examination, to 0.5 or even 0.33 micro-farads, in the course of a month or 6 weeks, only to find at operation that we were dealing with a complete lesion, presenting well formed bulbs at both proximal and peripheral ends. Repeated similar disclosures have shown us that improvement in the muscle belly does not run hand in hand with regeneration of the nerve.

The most reliable sign of complete or severe lesion is the replacement of the quick, flash-like response to galvanic stimulation by the slow, retarded relaxation, always, of course, accompanied by faradic inexcitability and, provided the muscles are maintained in good condition, we have never noted a complete disappearance of this reaction, during the period of time over which we were able to observe our cases, often amounting to 8 or 10 months from date of wound.

The so-called longitudinal reaction of Huet, though looked for, was seldom observed and, when so, was an accompaniment only of the characteristic galvanic response.

Erb's paradoxical reaction, viz., faradic excitability of the muscle or nerve below the lesion, while stimulation above the lesion fails to give response, indicates a partial and local lesion from which spontaneous recovery may be expected, but as it is applicable only to nerves, which, at some point, run a superficial course, its value in diagnosis is extremely limited.

Muscle atrophy, as an indication of the severity of the lesion, is of little clinical value as the most severe degrees of wasting are often observed in partial lesions and, in fact, appear to be more rapid in onset. Atrophy is always more apparent in its onset and extent in the smaller muscles, as is so often seen in partial lesions of the ulnar nerve, which have been allowed to rest for a week or two. In some of these cases, the extreme degree of wasting in the interossei and hypothenars suggests that we are dealing with a much more severe, if not complete lesion of the nerve. Atrophy would appear to depend solely on the nutritional and manipulative treatment, while

disuse of the limb or absence of manipulation engenders severe wasting of, not only the muscles, but also the underlying bone segments; witness the degree of bone atrophy, especially in the phalanges, which accompanies hysterical paralysis.

The same observation may be made in regard to trophic disturbance and on this point, we are in complete accord with Tinel and others, that the most extreme trophic disturbances accompany partial lesions, especially those of the irritative type. If any conclusion may be drawn from the evidence of trophic loss, it is that, with severe trophic change, we are dealing with an incomplete lesion of the nerve.

We have never been able to make any diagnostic use of the presence or absence of pain in the muscle bellies, as pain to pressure may be encountered in complete lesion of the nerve and is by no means a constant accompaniment of incomplete ones.

Formication over the distribution of a nerve, set up by pressure below the lesion, applies only in cases, in which the nerve trunk runs a superficial course, such as the ulnar and external popliteal and, when present, is a valuable indication of a recovering nerve. It is, however, an infrequent accompaniment of regeneration as it has been observed in a very small proportion of ulnar and external popliteal lesions.

A review, therefore, of the various signs would appear to produce few absolute and irrefutable indications of the condition of the nerve and, after all, one's diagnosis is practically a differentiation of the complete from the partial lesions.

Clinically, there is no advantage in pigeonholing each lesion under one or another syndrome, even if this were possible, but a reasonable opinion as to the integrity of the nerve should be possible from the general clinical picture.

The decision that a nerve is completely injured implies only physiological interruption, as, beyond the discovery of palpable end bulbs, there are no signs by which anatomical and physiological lesions may be differentiated.

Of all the signs, assigned to nerve injury, we consider that the presence or absence of true voluntary motor power offers the most valuable guide to an opinion, and while there are many pitfalls in the interpretation of motor power, chief among which are the supplementary movements, these, if recognized, should offer little difficulty.

The unmistakable return of voluntary power in a muscle, which, at first, may manifest itself in weak fibrillary contractions, is the surest and most frequent sign of a recovering nerve, and this nerve may now be treated under postural and nutritional conditions to a finality. If in three months following injury there is no perceptible voluntary movement, we are of the opinion that an exploratory operation is indicated and seldom has operation, under such conditions, been unnecessarily performed.

In recognizing, as we do, the impossibility of diagnosing the anatomical condition of the nerve and, in limiting our decision to that of physiological interruption, we have met with many cases, where uncertainty featured the diagnosis and, in these cases, time can be saved for both patient and staff by operation and direct inspection of the nerve, which procedure, in the hands of skilled operators, is not only safe and rational, but in many cases enhances the chance and rapidity of recovery to a considerable degree.

# PRE-OPERATIVE PREPARATION OF PATIENTS WITH OBSTRUCTIVE JAUNDICE

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THE fact that jaundiced patients bleed too freely following operation has been known for several years, and in the absence of exact criteria many surgeons have looked for one or another clinical sign for an index to the severity of the operative risk. Some surgeons believe that purpuric spots on the patient with obstructive jaundice are advance agents of death in case of operation; others believe that a blood coagulation time of more than 9 minutes is a contra-indication to operation, and still others that dehydration with marked jaundice persisting more than 2 or 3 weeks is a contra-indication. Further, there is no doubt that many cases of cholelithiasis and stones in the common duct have been diagnosed as malignant disease and the patients have been returned to a life of invalidism, since the surgeon did not wish to do an abdominal exploration because, in the presence of jaundice, it seemed to entail grave risk.

This study was made for the purpose of investigating the reason for the high mortality following operations on patients who have obstructive jaundice. The reports of patients from the records of the Mayo Clinic during 1918, 1919, and 1920, who had obstructive jaundice at the time of operation and who have died, were reviewed in order to determine the cause of death and the relation of such cause to the degree of jaundice and the coagulation time of the venous blood. Only cases in which coagulation time estimations had been made were tabulated.

In Table I a comparison is shown between the findings at necropsy in 29 patients with obstructive jaundice at the time of operation who died subsequently, and in 34 patients who were without jaundice at the time of operation who died. It is of interest to note that 15, more than 50 per cent, of the patients with jaundice died from intra-abdominal hæmorrhage, or at least had a large amount of blood in the peritoneal cavity, while but 6 per cent of those without jaundice died from intra-abdominal hæmorrhage.

Table II shows the degree of jaundice, coagulation time, and operative procedures on the 15 jaundiced patients who died from postoperative hæmorrhage. In 11 of the 15 patients (73 per cent) the coagulation time was more than 9 minutes. In 10 (66 per cent) the jaundice was graded 3 or 4 on a scale of 1, 2, 3, 4.

It is noteworthy that in all cases death occurred from 1 to 7 days after operation, as may be expected if continuous oozing is taking place. If the cystic artery or one of its branches were the cause, death might be expected immediately following operation. At necropsy in every instance the exact source of the hæmorrhage could not be found.

In order to determine whether deaths from hæmorrhage were dependent on an elevated coagulation time and marked jaundice, a study was made of the case histories of 14 patients, the only patients in whom comparisons had been made of the coagulation time and degree of jaundice, who were jaundiced at the time of operation on the bile tract, and who died from causes other than postoperative abdominal hæmorrhage. It was found that but 3 had had a coagulation time of more than 9 minutes and 5, jaundice graded 3 or 4 (Table III). Only 2 of the 14 had had cholecystectomies, the others some type of drainage operation on the bile-ducts.

TABLE I.—Findings at Necropsy in Patients Operated on for Lesions of the Gall-Bladder.

| | With jaundice | Without jaundice |
|---|---|---|
| Patients | 29 | 34 |
| Cause of death | | |
| Postoperative hæmorrhage | 16 | 2 |
| Peritonitis | 3 | 5 |
| Bronchopneumonia | 3 | 4 |
| Pulmonary embolism | | 6 |
| Cerebral embolism | | 1 |
| Ileus | | 3 |

TABLE II. — FIFTEEN JAUNDICED PATIENTS DYING FROM POSTOPERATIVE (INTRA-ABDOMINAL) HÆMORRHAGE

| Case | Age | Degree of jaundice | Degree of bile | Coagulation time, minutes | Calcium time, minutes | Operation |
|---|---|---|---|---|---|---|
| 341890 | 30 | 1 | 1 | 10 | 10 | Choledochotomy; cholecystectomy |
| 285570 | 18 | 2 | | 23 | 28 | Choledochotomy; cholecystectomy |
| 290103 | 34 | 2 | 2 | 8 | | Dilation of stricture; choledochotomy |
| 2[illegible]4-9 | 48 | 4 | 3 | 13½ | | Choledochotomy |
| 107347 | 37 | 4 | 4 | 18 | | Cholecystostomy |
| 335[illegible]7 | 55 | 3 | 2 | 15 | 11 | Exploration |
| 200585 | 43 | 3 | 2 | 8 | | Exploration |
| 241060 | 53 | 2 | 2 | 20 | | Cholecystectomy; choledochotomy |
| 285723 | 48 | 4 | 3 | 16 | | Dilation of stricture; choledochotomy |
| 231448 | 64 | 2 | 1 | 10 | 12½ | Cholecystectomy; choledochotomy |
| 226821 | 65 | 4 | 2 | 6 | 17 | Cholecystostomy; choledochotomy |
| 262802 | 29 | 4 | 3 | 36 | 35 | Dilation of common duct |
| 267424 | 57 | 3 | | 10 | 9 | Cholecystectomy. Removal of stones |
| 271033 | 39 | 4 | 2 | 17 | 11 | Choledochotomy |
| 328617 | 47 | 1 | 1 | 7½ | | Cholecystectomy. Closure of gall-bladder fistula |

Coagulation time more than 9 minutes in 11 of 15 patients. In 10 of 15 patients the jaundice was graded 3 or 4

These facts presented in Tables II and III seem to be direct evidence that the cause of death of most of the patients with obstructive jaundice was postoperative intra-abdominal hæmorrhage, which seemed to be due to a continual oozing from traumatized surfaces rather than bleeding from severed arteries. The corollary of this is that in deeply jaundiced patients the tissues should be handled with the utmost care and gentleness and oozing from the liver surface prevented by refraining from doing a cholecystectomy until the jaundice has subsided.

Two methods of determining the coagulation time of the blood are used in the Mayo Clinic: Boggs' method, in which estimation is made by the time required for blood from a stab wound in the ear to coagulate, and the method described by Lee and White, in which the coagulation time is determined by the time it takes for 1 cubic centimeter of blood withdrawn from a vein to coagulate. The blood is withdrawn by a syringe and placed in a test tube, both having previously been washed with normal salt solution. The Lee and White method is preferred because in Boggs' method the true coagulation time of the blood is shortened by the combination of the juices of the tissues of the ear with the blood as has been definitely shown by Lee and White. The test of the calcium time of the blood described by Lee and Vincent is also made in the Clinic. Six drops of a 0.5 per cent solution of calcium chloride are added to 1 cubic centimeter of venous blood, and the time required for the blood and the calcium chloride to coagulate is called the calcium time of the blood. These observers have shown that when the calcium time is lower than the coagulation time of the blood the coagulation time in most instances can be lowered to approximate the calcium time by the administration of calcium lactate by mouth for a three day period. They proved that a retarded coagulation time could be produced experimentally by producing an obstructive jaundice in dogs, and that this retardation of the coagulation time appeared at the end of the fifth week of the jaundice. They were able to produce an immediate reduction in the coagulation time of these

TABLE III. — FOURTEEN JAUNDICED PATIENTS DYING FROM CAUSES OTHER THAN HÆMORRHAGE

| Case | Degree of jaundice | Degree of bile | Coagulation time, minutes | Calcium time, minutes | Operation | Cause of death |
|---|---|---|---|---|---|---|
| 327011 | 2 | 2 | 5 | 8 | Cholecystogastrostomy | Suppression of urine |
| 306030 | 4 | 3 | 6 | 9 | Cholecystostomy; choledochotomy | Bronchopneumonia |
| 209833 | 3 | Trace | 6 | | Transduodenal excision of carcinoma | Peritonitis from rupture of incision |
| 253416 | 1 | 1 | 10 | 12 | Removal of specimen | Bronchopneumonia |
| 212281 | 1 | 2 | 5½ | | Cholecystostomy; choledochotomy | Peritonitis |
| 183880 | 3+ | 4 | 12 | 20 | Hepaticoduodenostomy; exploration of ducts | Abscess of liver; purulent pericarditis |
| 211383 | 1 | 1 | 11 | | Choledochotomy; exploration of common duct | Thrombosis of portal vein; abscess of liver |
| 199201 | 4 | 3 | 9 | 11 | Choledochotomy | Nephritis following transfusion from wrong donor |
| 189104 | 2 | 2 | 6 | 8 | Cholecystostomy | Peritonitis |
| 192733 | 3 | 2 | 8 | | Cholecystectomy; choledochotomy | Tuberculosis; bronchopneumonia |
| 24548 | 2 | 2 | 7 | | Cholecyctostomy; choledochotomy | Fat necrosis? |
| 214253 | 2 | 2 | 7 | | Cholecystostomy; choledochotomy | Cholangeitis |
| 350691 | 1 | 0 | 7½ | 4¼ | Cholecystectomy | Necrosis of the head of pancreas |
| 352666 | 2 | + | 8 | | Cholecystostomy | Questionable |

Coagulation time more than 9 minutes in 3 of 14 patients. In 5 of 14 patients the jaundice was graded 3 or 4.

animals by intravenous injections of 2 per cent calcium lactate, such reduction being sustained for from 2 to 3 days, without deleterious effect on the general condition of the animals.

Besides lowering the coagulation time by calcium, some observers believe that calcium is beneficial in decreasing the toxicity of patients with obstructive jaundice. Among the most noteworthy theories is that of King and Stewart who believe that bile pigments in combination with calcium or with sodium are less toxic than uncombined pigments; they consider calcium a protective mechanism against circulating pigments of obstructive jaundice.

King, Bigelow, and Pearce conclude that obstructive jaundice produced in dogs results in a loss of calcium, the calcium being given up by the bone to neutralize the toxic bile pigments circulating in the blood and tissues. Such neutralization affords protection to the body, but may lead to secondary disturbances, for example bradycardia and changes in the blood coagulation time. In view of the work of these investigators the belief seems justified that calcium offers the best means of preparing jaundiced patients for operation, since it not only reduces the coagulation time of the blood, but also decreases the toxicity produced by the circulating bile pigments. We have adopted the suggestion of Lee and Vincent to use calcium intravenously. From 5 to 10 cubic centimeters of a 10 per cent solution of calcium chloride in redistilled water, which was given each of 6 patients with obstructive jaundice who had abnormally high blood coagulation times, lowered the coagulation time to normal after three injections on successive days. In addition 4 of these patients were given calcium lactate by mouth in doses of 100 grains daily (Table IV).

Recently Grove and Vines have stated that they have proved experimentally that calcium salts given by mouth have no influence on the blood calcium, in which case the administration of calcium intravenously is the method of choice, since the calcium not only lowers the coagulation time of the blood, but also combines with the bile pigments circulating in the blood stream.

That the intravenous injection of calcium in small doses is not a harmful procedure has

TABLE IV.— THE EFFECT OF PRE-OPERATIVE PREPARATION ON THE COAGULATION TIME OF VENOUS BLOOD IN PATIENTS WITH OBSTRUCTIVE JAUNDICE

| Case | Age | Degree of jaundice | Degree of bile | Coagulation time, minutes | Calcium time, minutes | Coagulation time after preparation, minutes | Preparation |
|---|---|---|---|---|---|---|---|
| 352536 H.H.E | 54 | 4 | 3 | 10 | 12 | 6½ | 5 ccm. 10% calcium chloride intravenously, daily, 3 days<br>100 gr. calcium lactate daily, 4 days<br>Carbohydrate diet<br>4000 ccm. water daily |
| 349070 M. | 55 | 3 | 3 | 14 | 9 | 2* | 5 ccm. 10% calcium chloride, intravenously, daily, 2 days<br>100 gr. calcium lactate daily, 4 days<br>Carbohydrate diet<br>3% glucose solution proctoclysis<br>4000 ccm. water daily |
| 353078 J.F.W. | 55 | 4 | 2 | 10 | | 5** | 100 gr. calcium lactate daily, 5 days<br>Carbohydrate diet<br>3% glucose solution proctoclysis<br>4000 ccm. water daily |
| 357857 J.L.T | 60 | 4 | 4 | 12<br>(5/6/21) | 12<br>(5/6/21) | 6<br>(5/17/21) | 5 ccm. 10% calcium chloride intravenously, daily, 3 days<br>100 gr. calcium lactate daily, 5 days<br>15% glucose solution proctoclysis<br>4000 ccm. water daily |
| 357833 L.B. | 46 | 4 | 4 | 5½<br>(5/14/21) | 5½ | 4<br>(5/16/21) | 5 ccm. 10% calcium lactate intravenously, daily, 2 days<br>100 gr. calcium lactate daily, 4 days<br>Glucose solution proctoclysis<br>4000 ccm. water daily, 4 days |
| 309420 C.C.T *** | 47 | 4 | 4 | 9 | 12 | 2 | 5 ccm. 10% calcium chloride intravenously, daily, 3 days<br>10% glucose solution proctoclysis<br>4000 ccm. water daily<br>Carbohydrate diet |
| 280331 F.F | 50 | 4 | 4 | 6 | 2 | 2 | 5 ccm. 10% calcium chloride intravenously, daily, 3 days<br>10% glucose proctoclysis<br>4000 ccm. water daily<br>Carbohydrate diet |

*Twenty-two days after operation the coagulation time was 5 minutes and 15 seconds. The jaundice was greatly decreased.
**Fifteen days after operation coagulation time was 3 minutes, 40 seconds; marked diminution in jaundice. Thirty days after operation coagulation time was 5½ minutes.
***Patient had bleeding gums, petechia, and subcutaneous hæmorrhages which began to disappear after the intravenous injections of calcium, and did not reappear.

been proved (Lee and Vincent). Cambell has given calcium acetyl salicylate to 55 patients in doses of 0.5 grams in 10 cubic centimeters of distilled water (a concentration similar to our calcium chloride solution) at three day intervals, in some cases as many as seven injections for relief of neuralgias and myalgias. This emphasizes the fact that calcium in small doses may be given intravenously without deleterious effect. I have given 10 cubic centimeters of calcium chloride in 10 per cent solution and 10 cubic centimeters of calcium lactate in 10 per cent solution separately to two pregnant dogs over a seven day period without any apparent ill effect. During the course of these injections both dogs delivered several living puppies.

The intravenous injections of calcium chloride in patients have been supplemented by doses of calcium by mouth, although Cushny states that "the small quantity of calcium absorbed from the alimentary canal has no obvious effects." This statement does not always hold good since some reduction in an elevated coagulation time can be brought about by the administration of calcium lactate by mouth, although inasmuch as it does not increase the amount of calcium in the blood stream (Grove and Vines), and hence does not combine with the bile pigments circulating in the blood, it does not diminish the patients' toxicity and consequently its value is 50 per cent less than the intravenous administration of calcium. Furthermore, the calcium administered by mouth was found by Lee and Vincent to have little effect in lowering an elevated blood coagulation time until after the third day, while the effect of the intravenous administration of calcium is noticed immediately This is illustrated in Case 353678 (Table IV). The patient showed a reduction in coagulation time to normal after the oral administration of 100 grains of calcium lactate daily for 5 days.

It should be borne in mind that "calcium injected directly into the blood stream acts much like digitalis in that in small doses it accelerates and strengthens the heart, but in large doses it seems to be poisonous, tending to bring the heart to a standstill" (Cushny). In our investigations daily injections of 10 cubic centimeters of 10 per cent calcium lactate and 10 per cent calcium chloride were given for a seven day period without apparent deleterious effect on dogs, and since a maximum of three injections of 5 cubic centimeters of 10 per cent calcium chloride has sufficed to produce a prompt, immediate, and sustained reduction of the coagulation time the intravenous use of the calcium chloride solution in preparing jaundiced patients seems justifiable.

The duration of the reduction in coagulation time for each injection of calcium lactate was found by Lee and Vincent to be 3 days. In our cases we have not definitely determined this point, a study of which will be made later. However, in one case the reduction remained for 14 days, in another 8 days. When the coagulation time tended to lengthen we found that it could be immediately reduced by another intravenous injection of the calcium chloride solution.

Opie, from his experimental work, believes that carbohydrates act in a protective manner to prevent disintegration of the body proteins when the individual is in a state of toxæmia; he found that on giving carbohydrates, fats, and proteins to dogs, before and after chloroform poisoning, the dogs that were fed with fat died first, those fed with protein died second, and those fed with carbohydrate died third or not at all. Mann has been able to keep dogs alive for from 20 to 34 days after the removal of the liver by intravenous, subcutaneous, and intraduodenal injections of glucose. In view of this work, jaundiced patients in the Clinic have been fed large quantities of carbohydrates, and the amount of glucose has been increased by using the Murphy drip proctoclysis of 15 per cent glucose solution in tap water, one hour on and one hour off. Four thousand cubic centimeters of water were given by mouth every 24 hours to increase the body fluids and to aid in the elimination of the bile pigments. Attempts have not been made to carry on these preparations longer than 4 days, because it is believed that this length of time will give the maximum benefit, and that waiting longer might invite another attack of colic, if gallstones are the cause of the biliary obstruction, which would deepen the jaundice and increase the coagulation time. If the patient does not respond to this regimen transfusion of blood is indicated 24 to 48 hours before operation.

In this manner we have prepared for operation 15 patients with obstructive jaundice most of whom would otherwise have been denied operation because of the grave risk due to their elevated coagulation time, dehydration and toxæmia. All of these patients recovered from the operation and were able to return home.

The facts brought out in the study of these cases are illustrated by Case 339670.

Mrs. M., aged 56 years, gave a history of increasing jaundice over a period of 24 months with marked loss of weight and strength. She had had severe abdominal colic often. The large liver and the fluctuating abdomen led several physicians to believe that the bile-ducts and liver were malignant. When her coagulation time was reported to be 14 minutes, it was thought that the operative risk was too great, particularly since the symptoms were 75 per cent in favor of malignancy. The conditions were explained to her, but she refused to leave the Clinic without an operation. She was, therefore, prepared for operation in the manner described and her coagulation time reduced from 14 minutes to 2 minutes in 4 days. At operation stones in the common duct and secondary biliary cirrhosis were found. There was no evidence of malignancy. The patient recovered, and was dismissed from the Clinic 28 days later.

## CONCLUSIONS

1. Most patients with obstructive jaundice who die after operation succumb from intra-abdominal hæmorrhage.

2. In most cases postoperative hæmorrhage occurs when the coagulation time of the venous blood is longer than 9 minutes.

3. The coagulation time of the blood can be reduced greatly and the toxicity diminished in patients with obstructive jaundice by daily intravenous injections of 5 cubic centimeters of a 10 per cent calcium chloride solution for a three day period.

4. Carbohydrates and glucose prevent disintegration of body proteins when the patient is in a state of toxæmia.

5. Large quantities of water aid in eliminating toxic bile pigments and increase the body fluids.

6. It is self evident that in operations for obstructive jaundice the various steps of the operation be carried out with the utmost gentleness, care being taken not to traumatize the tissues, especially of the liver, and for this reason cholecystectomy should not be performed at the primary operation if it can be avoided.

I wish to express my thanks to Dr. L. P. Bell for many valuable suggestions received from him and from his thesis "Degeneration and Regeneration of the Liver during Experimentally Produced Obstructive Jaundice" (unpublished).

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# BLOOD VESSEL SUTURE[1]

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DURING the past few years a great deal has been written on the subject of vascular suture. It is my purpose in this paper to present a short résumé of the subject and to discuss briefly: (I) the structure of arteries and veins; (II) the indications for suture of the blood vessels; (III) the contra-indications; (IV) the basic principles underlying the different methods of vascular suture and the various suturing operations that may be done; (V) the more commonly accepted methods, in an attempt to make clear and to emphasize the fact that the one method which gives the very best possible results is so extremely simple that any surgeon who possesses even average dexterity can use it, without any special instruments and with only the materials that can be obtained at any dry goods store; (VI) the process of healing of an artery or vein after suture; and (VII) my own experimental experience stating my own views on the subject and bringing in only as many references from the literature as are necessary to emphasize and make clear the above points. I shall not go into the historical aspect of the subject because it has nothing to do with the practical work. Those interested in it will find the excellent articles by Imbert and Fiolle (1), and J. B. Murphy (2) well worth reading. Neither shall I touch upon the surgery of aneurisms which has been so fully covered by Matas (3) and others. I wish merely to discuss the suture of arteries and veins, as it may be met with in ordinary surgical practice, for this is intended to be a very practical paper.

## I. STRUCTURE OF ARTERIES AND VEINS (4)

In the case of medium sized and large vessels the structure is about the same, with certain modifications. The medium sized or large artery, which is the one we are called upon to suture most frequently is composed of the following coats: the inner coat or tunica intima, the middle coat or tunica media, and the outer coat or tunica adventitia. The inner coat consists of a layer of endothelial cells, a subendothelial layer of connective tissue, and a layer of elastic tissue, the fibers of which have principally a longitudinal direction. The middle coat consists of plain muscle fibers, arranged circularly around the vessel, and elastic fibers, the laminæ of which alternate with layers of muscular fiber. The tunica media is the coat that gives thickness to the artery. The external coat consists of bundles of white connective tissue with some elastic fibers. This coat is easily separated from the tunica media when the vessel is exposed, as will be seen later.

The structures of an artery and a vein of medium size differ principally as follows: (1) The elastic layer of the internal coat in a vein is not so highly developed. (2) The middle coat is composed of a thick layer of white connective tissue with elastic fibers, the latter in smaller proportion than in the arteries. In some veins there is a transverse layer of plain muscle fibers. The muscular element in veins, however, is much less prominent than in arteries, and the middle coat is, therefore, much weaker. (3) The outer coat is made up of areolar tissue with longitudinal elastic fibers. In the largest veins the outer coat is very thick and contains a large number of longitudinal muscular fibers. (4) Most veins are provided with valves, which prevent regurgitation of blood in them.

Both arteries and veins contain blood vessels for their nourishment. These are found in the outer coat. There are also nerves which have their origin in the sympathetic system and control the muscle fibers of the middle coat.

## II. INDICATIONS

Let me say at the outset that the indications for vascular suture are rare, and that the indications combined with conditions, essential for a good result, are extremely rare. However, the surgeon should be acquainted with the technique of the simplest and best

[1] Read before the Ohio Valley Medical Association, Evansville, Indiana, November 16, 1921.

methods so that, should occasion arise, he may be able to suture an important artery or vein as readily as he would the stomach or intestine. Leaving the ordinary aneurisms out of consideration, the indications for suture are the following:

1. Injury to the vessel, with break in its continuity, from any cause, either from without, as in gunshot or stab wounds, or from within (subcutaneous), as in fractures or dislocations or traction on the vessels, as in attempting to reduce a dislocation, or straighten a limb that has been in the flexed position for a prolonged period of time.

2. Where a vessel has been resected in a surgical operation, as may be the case in the removal of certain growths involving the artery or vein, or both, or where a vessel has been accidentally injured during the course of a surgical operation, as in the removal of enlarged glands or new-growths from the neck, axilla, or groin. The femoral artery and vein have frequently been injured during hernia operations, either by passing the needle through one of them or through the deep epigastric artery at its origin. This may require lateral suture.

3. Arteriovenous anastomosis for embolism and thrombosis of the lower extremity, Raynaud's disease, senile gangrene, etc. This is no longer considered an indication by the majority of surgeons, however, as it is usually a failure. These are the main indications for vessel suture, though of course there are many others—notably sacculated and arteriovenous aneurisms, where end-to-end or lateral suture may be necessary.

In the foregoing remarks I have referred particularly to arterial suture. This is because the arteries are far more important than the veins—from the standpoint of vessel suture—as the latter, except the larger ones, may be ligated with impunity, the anastomoses being very free and the superficial veins taking on the function of the deeper ones, when the latter are ligated. This is also the reason why arteriovenous anastomosis is never successful in embolism and thrombosis of the larger vessels of the extremities, or in Raynaud's disease or senile gangrene. The arterial blood turned into a large vein follows the line of least resistance and returns to the heart through the numerous superficial anastomoses—never reaching the capillaries at all. Of course, in the early part of this reversed circulation, the valves in the veins tend to stop the onward flow of blood in them, but they soon break down, as the veins dilate.

As regards the size and importance of vessels: It is hardly worth while suturing the internal jugular vein. Simply tie it off above and below the site of injury, or the tumor which involves it; but it is *always worth while* to suture the common or internal carotid artery, as ligation of either of these is dangerous, due to the fact that cerebral complications so frequently follow. The mortality usually given for ligation of the common carotid artery is 25 per cent, though some operators think this is much too high.

The same remarks apply to the brachial, axillary, subclavian, femoral and popliteal vessels. The *veins*, where suture is absolutely indicated, are the ascending vena cava, especially if the injury is above the entrance of the renal veins. All cases of ligation above its junction with these veins have ended fatally. The sinuses of the dura mater, also, should always be sutured if injured.

I have used the adjective "important" in connection with the arteries. This is because suture is nearly always indicated only in the case of the larger and "important" arteries. The smaller ones may usually be ligated without risk. For instance the ulnar may be ligated and the radial will take care of the circulation of the hand and vice versa. One must always be certain, however, that the other vessel is intact and patent, otherwise suture must be performed. The external carotid is an unimportant artery. The subclavian is an important one, but difficult of suture in all its portions, unless the clavicle is divided and retracted downward. The axillary and brachial arteries are important but decreasingly so as we pass downward. They should always be sutured when possible. Circular or lateral suture of the abdominal aorta is imperative when it has been injured, as all cases of ligation have been fatal. Ligation of the common and external iliac

arteries is dangerous, and also of the femoral and popliteal, because of the liability to gangrene of some portion of the leg or foot. In all these cases suture should be performed if possible. The anterior and posterior tibial and peroneal arteries may, any one of them, be tied without danger.

The conditions which make for success in vascular suture are the following:

*1. Absolute asepsis.* All surgeons and experimenters agree that infection of the field will invariably result in failure, either from intravascular thrombosis or secondary hæmorrhage, so this one absolute rule can be laid down; if the wound is infected or there is infection in the immediate neighborhood of the injured vessel, do not attempt to suture, but always ligate using the Ballance and Edmunds knot on the larger arteries. The reason that vascular suture can be so seldom used, is because the wounds are usually infected when they come under the care of the surgeon. This was the reason that, during the Great War, so few injured vessels were successfully sutured. In the experimental laboratory, where asepsis can be carried out in all its details, the larger vessels can be sutured with almost 100 per cent certainty of success, but in practical surgery this is not so. If the vessel is injured during the course of an aseptic operation, there is no reason why the same good results cannot be obtained as in the laboratory, and this also applies to operations on aneurisms, or the resection of large vessels during the removal of tumors and glands in an aseptic field. In gunshot and stab wounds, however, infection is very likely to be carried in, especially in the case of shrapnel wounds, and in compound fractures where the vessels are injured.

*2. Absence of tension between the united segments of artery or vein.* If much of the vessel is destroyed or a considerable portion has to be cut away in order to secure clean cut ends for union, the tension may be so great that suture is inadvisable. This, of course, must be left to the judgment of the surgeon but I would say that if the tension is great enough to make the anastomosis difficult—ligate instead of suture.

*3. Avoidance of injury to the intima.* This is rather important and no more injury to the intima, than is absolutely necessary, should be inflicted. With this end in view, one should never use an ordinary artery forceps to secure the temporary hæmostasis necessary in vascular suture. The best instrument for this purpose is the Crile screw clamp, with or without rubber tubes over the blades, but if these are not at hand, as might easily happen in an emergency case, any ordinary hæmostat may be made to serve, as is shown in Figure 1. Here small rubber tubes are drawn over the blades of the hæmostat and a narrow elastic band is wound around the shafts, above the clasp and below the finger rings. The tension is regulated by the number of turns of this rubber band. By means of this appliance, injury of the intima is impossible. Of course, in every anastomosis of an artery or vein, there must of necessity be some injury to the intima at the line of union, because even by the most perfect eversion methods, the endothelial surfaces cannot be so perfectly and evenly approximated, that the sutures, pins or clamps, or the injured endothelium, through which they pass, will not at some point be in contact with the blood stream. If, however, these slight injuries be aseptic, the microscopic coagula, which form at their sites, will be quickly covered by endothelial cells from each end, and no occlusion or even narrowing of the vessel, will result. Even in the case of the through-and-through stitch, where the suture material is exposed to the blood stream, if perfect asepsis exists, the suture material will be quickly covered with endothelium and not the slightest harm ensue. However, so long as injury to the intima is a source of danger and can be avoided to some extent, every precaution should be taken to prevent it.

The very finest toothed tissue forceps should be used in handling the ends of the vessels while suturing and the very finest needles and suture material obtainable should be employed. The latter can always be obtained, and if one has not the fine toothed forceps, the larger ones without teeth may be used.

So much for injury of the intima.

*4. Keeping the exposed ends of the vessels moist with warm normal salt solution* throughout the operation and preventing them from coming in contact with the surrounding tissues, all of which contain coagulating substances. This is easily done by placing a piece of aseptic gauze, soaked in normal salt solution, under the vessel ends and frequently flushing out the ends with the same solution by squeezing it from another sponge. Drying of the vessel ends favors coagulation, as does contact with other tissues.

*5. Preventing the adventitia from coming between the injured ends of the vessel.* When an artery is severed, the ends immediately retract from each other and the loose adventitia tends to plug them, thus partly stopping the hæmorrhage. As will be seen later, the first step in every anastomosis is to pull the adventitia over the severed ends as far as possible and cut it off. It used to be thought that any interference with the outer coat was likely to cause disturbances of nutrition of the vessel wall, but now we know that this is not true, at least to the extent of cutting off the redundant portion.

### III. CONTRA-INDICATIONS

I think that the contra-indications have been quite fully brought out in a negative manner in the foregoing. (1) Sepsis is the principle contra-indication, (2) any considerable degree of tension between the ends of the vessel, (3) when the general condition of the patient is such that he is unable to stand the rather prolonged operation of vessel suture, (4) when the vessel is so severely injured that it cannot be repaired, (5) when the injured vessel is so inaccessible that suture is impossible, and (6) where there is a marked degree of arteriosclerosis.

The results of vascular suture are most favorable when the ideal conditions mentioned are present. These ideal conditions, however, are rarely combined in one case; therefore, we seldom see a perfect result. They have been reported in the literature, however, by unprejudiced observers, and with these precedents in mind, we should always employ the procedure when indicated and possible.

### IV. THE BASIC PRINCIPLES UNDERLYING THE DIFFERENT OPERATIONS OF VASCULAR SUTURE

Under this head I shall mention first the simplest method, namely: direct end-to-end, side-to-side or end-to-side anastomosis, the suture material penetrating all of the coats or all except the intima. This is best exemplified in the methods of Carrel and Glueck. Second, the eversion methods, either by means of sutures only (Dorrance, Salomoni and Tomaselli, Smith and Bickham), or by means of absorbable magnesium rings (Lespinasse); third, the invagination method of Murphy, where the proximal end is drawn into or invaginated into the distal end; fourth, the combination of eversion and invagination methods, as the method of Payr. One of these four basic principles underlies every arterial anastomosis, except, of course, where a paraffined tube of metal or glass is used temporarily to carry on the circulation. As the latter must of necessity be temporary, I shall not consider it.

The different suturing operations which may be done on the blood vessels are the following: (1) End-to-end union of artery or vein. (2) End-to-side union of artery or vein. (3) Side-to-side union of artery or vein. (4) Lateral suture of artery or vein for injury, or in the treatment of arteriovenous aneurisms, after extirpation of the sac. The method of Matas is also a lateral suture method, though in this, the everting sutures are introduced within the sac, thereby obliterating it. (5) Arteriovenous anastomosis,—usually end-to-end, though it may be end-to-side (end of vein in the side of artery). (6) Transplantation of a segment of vein into an arterial defect. This may be done by taking the segment from the patient at the time of operation and making two end-to-end sutures, in cases where too much of the artery has been destroyed to do a direct end-to-end anastomosis; or "cold storage" transplantation may be done, either with segments of human veins, kept in normal salt solution at a temperature of 32 to 34° F., or segments of veins from one of the lower animals, as the sheep or dog, kept in cold storage until used. Most of these latter operations have been

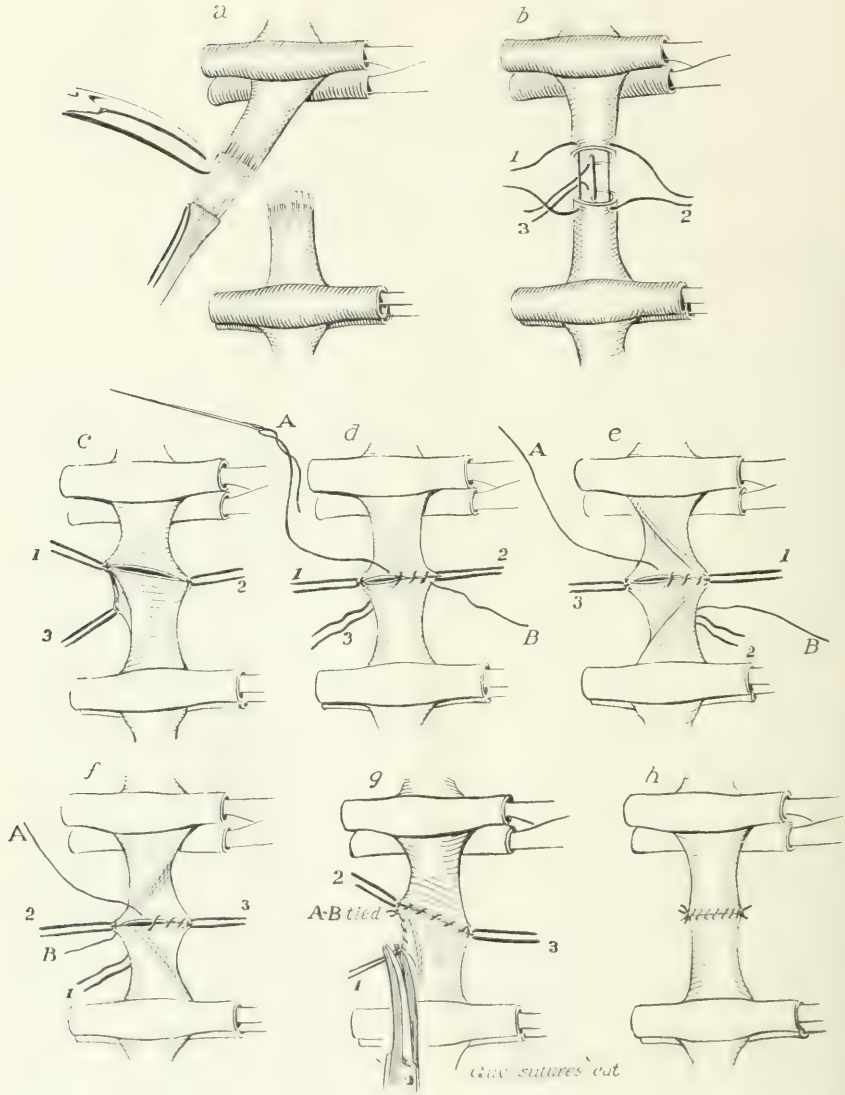
done in the laboratory, though a very few have been performed on man, without success so far as I know. (7) Patching an arterial defect with a piece of fascia, peritoneum, or the wall of a vein. This, too, is a laboratory operation. The patch is simply sewed into the defect, the sutures passing through all of the coats, or all except the intima.

### V. TECHNIQUE OF DIFFERENT METHODS

I shall first describe the technique of the method, which I consider the best of all, that of Carrel, as it is so simple that any surgeon can carry it out with materials that may be procured at any dry goods store. The instruments and materials necessary are the following: Three or four very fine straight sewing needles (Fig. 2), Nos. 12 or 14 preferred, with as long an eye as possible to facilitate threading, the same number of lengths of fine silk thread, Nos. 0, 00 or 000 preferred, each 16 to 20 inches long (the needles are threaded with the silk before sterilizing); two Crile screw clamps, or ordinary hæmostats arranged as described above with the rubber tubes over the blades and narrow rubber bands wound around the shafts near the finger rings to keep the blades in apposition, two fine toothed tissue forceps for handling the ends of the arterial segments; sharp straight manicure scissors; sterile vaseline, with which to coat the needles and thread; sterile warm normal salt solution with gauze sponges, etc.; scalpel, artery forceps, and scissors.

These materials are necessary in nearly all methods, so I shall not repeat, in my description of other techniques.

After preparing the field carefully as for any other aseptic operation, the artery to be sutured is cut down upon and exposed. Any clots are turned out and if the vessel is actively bleeding, digital pressure should be used to control it. It is well to expose the vessel for at least 1¼ inches above and below the site of injury, so that it may be handled without too much traumatism. Next, place a Crile screw clamp on each segment of the vessel, about 1 inch from the severed end and, by means of the screw, compress the vessel just enough to stop the flow of blood. The field should now be cleansed with sterile normal salt solution, and a dressing soaked with it placed under the vessel to prevent contact with the surrounding tissues. Wash out the ends of the segments with the same solution and keep them moist throughout the operation. If the ends of the segments are ragged and uneven, cut them squarely across so that the ends to be united will be sharp and regular. Now with a fine toothed forceps draw the adventitia over the ends of the vessel and cut it off with a sharp manicure scissors (Fig. 3). The threaded needles and silk should be dipped in sterile melted vaseline or paraffin oil, if they have not already been sterilized in them. This answers a three-fold purpose: it prevents coagulation of blood on the sutures which are exposed in the blood stream, the sutures slip through the vessel walls more easily, and the vaseline tends to plug the perforations produced by the needles, by accumulating around the silk. A silk suture is passed through the entire thickness of the vessel wall of one segment from without inward, as near the end as possible, and then through the opposing end in the same manner but from within outward, penetrating the two ends in exactly corresponding positions, as the vessel lies in the field. The two ends of the silk are now grasped in a hæmostat and this constitutes guy rope number 1. Guy rope number 2 is passed in exactly the same manner at a distance, one third around the circumference of the vessel from number 1. Guy rope number 3 is passed in the same way —one third of the circumference from number 2. Thus we have three guy ropes uniting the two ends of the vessel, equidistant from each other and all held by hæmostats (Figs. 3–10, *b*). The assistant now brings the ends of the vessel together and the three guy ropes are tied (Figs. 3–10, *c*), the long ends being still held with hæmostats. Now the assistant makes traction on guy ropes 1 and 2, allowing guy rope 3 to *drop*. This converts the circular circumference of the artery into a triangle, as shown in *c*, Figs. 3–10. With the arterial ends held in this manner, a continuous suture of the same fine silk on another very fine needle is started at guy rope number 2, where it is tied, and continued through all coats of the vessel, as an over and over stitch, uniting the




Figs. 3 to 10. (Legends on opposite page.)

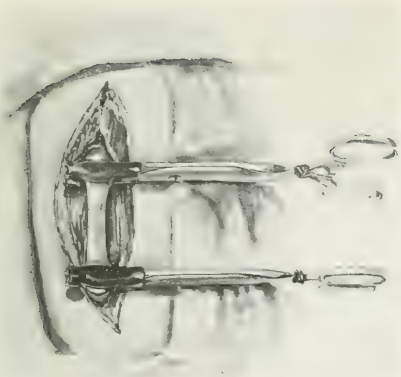


Fig. 1. An ordinary hæmostat which may be made to take the place of the Crile clamp.

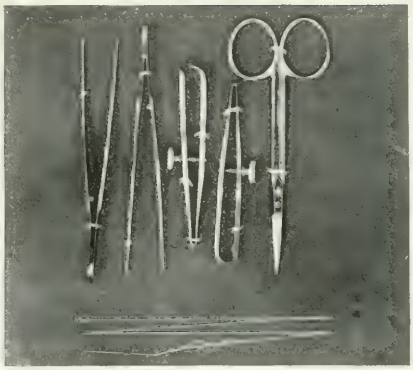


Fig. 2. The instruments used in suture of the vessels.

edges accurately as shown in *d*, Figures 3 to 10. The sutures are introduced as closely to the edges as possible and as *near* together as is necessary to secure perfect approximation. When guy rope number 1 is reached the suture is continued around it and traction is made on guy ropes numbers 3 and 1, 2 being dropped. This twists the vessel through a third of its circumference and brings the edges of the vessel between 3 and 1 into the field, as shown in *e*, Figures 3 to 10. These edges are united in exactly the same manner by the same continuous suture, passing through all of the coats, until guy rope 3 is reached. The suture is passed around 3 and traction is made on guy ropes numbers 2 and 3, dropping number 1, as shown in *f*, Figures 3 to 10. This brings the last side of the triangle into the field and the same suturing process is continued between 2 and 3, the end of the continuous suture being tied to its beginning, or to guy rope 2, where it began. The circular suture is now complete and all that remains to do is to cut the guy ropes and suture ends close to the vessel, as shown in *g*, Figures 3 to 10, when we will have a perfect circular end-to-end anastomosis, as shown in *h*, Figures 3 to 10. The distal Crile clamp is now removed and then the proximal one. When the circulation is re-established, there will be bleeding through some of the stitch holes, especially where the guy ropes were inserted, but this invariably stops after a few minutes' light compression with a gauze sponge soaked in warm normal salt solution. It is not necessary to suture the sheath of the vessel over the line of suture, but simply allow the muscles to fall back into place, suture the deep fascia at a few points and carefully close the wound in the skin. I have described Carrel's method in detail because I am convinced from my experimental work that it is

Fig. 3 (*a*). The clamps are in place on the vessel and the adventitia is being drawn over the end of the vessel, about to be cut off by the scissors.

Fig. 4 (*b*). The three guy rope sutures, equidistant from each other are in place, having been passed through all coats of the vessel. Guy ropes 1, 2 and 3.

Fig. 5 (*c*). Guy ropes 1, 2, and 3 are tied, traction is being made on them and the circular circumference of the artery is converted into a triangle.

Fig. 6 (*d*). The continuous silk suture has been started at 2, and is uniting the edges, passing through all of the coats.

Fig. 7 (*e*). Traction is now being made on guy ropes 1 and 3, twisting the vessel through one-third of its circumference. The same continuous suture, *b*, is shown passing through all coats of the vessel.

Fig. 8 (*f*). The continuous suture, *b*, has passed guy rope 3, traction is being made on 2 and 3, after having passed 3 beneath the vessel. Traction on 2 and 3 now twists the vessel through another one-third of its circumference, but in the opposite direction.

Fig. 9 (*g*). The continuous suture around the vessel is now complete and the guy ropes are being cut.

Fig. 10 (*h*). The guy ropes and continuous sutures have been cut and the end-to-end anastomosis is complete.

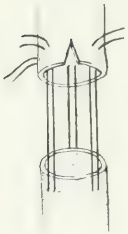


Fig. 11.

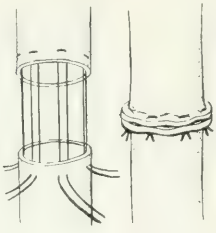


Fig. 12.

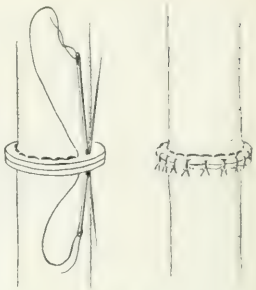


Fig. 13.

Fig. 11. The invagination method of Murphy. Shows the distal end split a short distance, and the three invaginating guy ropes in position, ready to draw the proximal into the distal end. The second picture shows the operation complete, with the guy ropes tied and cut, the slit sutured, and the fixation sutures in position.

Fig. 12. Shows the eversion method which may be accomplished by either the interrupted or continuous suture. Another continuous over-and-over stitch may be used to unite the free edges, and thus produce a more perfect union.

Fig. 13. Showing the cobbler's stitch. This produces an eversion of the edges, which are united by a second row of interrupted sutures.

the best and gives the highest percentage of successful results. I have used it many times on the common carotid and femoral in dogs and once in the horse, with 80 per cent perfect results. It is the one method among all others that any surgeon can use with materials that are always at hand. If a small vessel must be sutured, the ends should be cut obliquely, to make the approximating surfaces as large in surface extent, as possible.

The invagination method of Murphy is shown in Figure 11. The same preliminaries are carried out as described for Carrel's method. The distal segment is split a short distance so that it may receive the proximal end which is drawn into it by three mattress sutures, placed equidistant, as near the end as possible and penetrating only the outer and middle coats. These sutures carry a fine

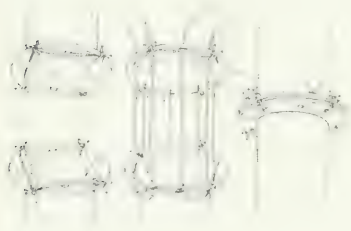


Fig. 14.

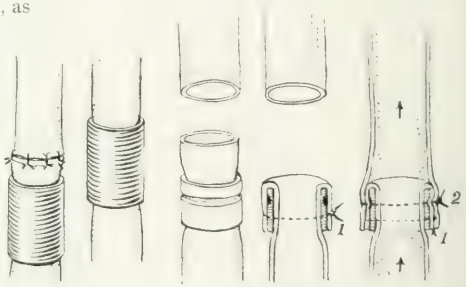



Fig. 15. Fig. 16.

Fig. 14. This drawing is almost self-explanatory. The magnesium rings are held in position on the two vessel ends by 4 guy ropes, which produce an eversion of the ends. The second picture shows the mattress sutures in place, while the third shows the vessel ends brought together, the mattress sutures tied, and cut. The introduction and position of the sutures is well shown. The method of Lespinasse.

Fig. 15. The method of Glueck. The ends are united by interrupted sutures, which penetrate all the coats, except the intima. A cuff of artery or vein, previously drawn over one segment, is now made to cover the line of suture.

Fig. 16. The method of Payr. A cylinder of metallic magnesium has been slipped over the proximal segment, with the groove toward the vessel end. In the second picture the end has been everted over the cylinder and tied onto it back of the groove. In the third picture, the distal segment has been drawn over the proximal and secured by another suture tied in the groove.

Fig. 17. The method of application of the plates of Lespinasse. Guy ropes are inserted at each end of the wound to put it on the stretch, a plate is placed on each side and secured by mattress sutures as shown.

needle at each end, and after being inserted into the proximal segment, penetrate the distal, from within outward in corresponding positions. After all of them are inserted, traction is made and the invagination thus produced. They are then tied, the slit is closed, and the distal segment secured to the proximal by a few interrupted sutures as shown in Figure 11.

The main objections to the invagination method are the following: too much of the artery is used in making the anastomosis; the lumen is narrowed to a considerable degree, as would be the inside diameter of any flexible tube if it were cut across and one end drawn into the other; the cut end of the proximal portion is exposed in the distal segment, and is in contact with the blood stream. This, of course, favors coagulation. In the few cases in which I tried it on the dog, intravascular thrombosis always resulted.

The principal eversion methods are those of Salomoni and Tomaselli, Dorrance, Smith, Bickham, and Lespinasse. The first five employ suture materials only; the last, rings of metallic magnesium. In the method of Dorrance a fine needle, carrying fine silk is passed as near the edge as possible in one cut end, from without inward, through all coats, and through the other in a similar manner, but from within out. It is then carried on as a continuous stitch, passing from without inward, on the last segment and from within out on the first, until the entire circumference is approximated. This is reinforced by a continuous over-and-over suture uniting the edges. Instead of a continuous mattress suture, interrupted ones may be used, accomplishing the same result. (See Fig. 12.) As will be seen from the illustration an eversion of both ends is thus produced. Smith used a fine thread sewing machine needle, on a handle, introducing the needle from without inward on one end and from within out at the corresponding position of the other end. He then passed a piece of catgut or kangaroo tendon through the loop on the farther side and, after withdrawing the needle, tied the silk over another piece of catgut on the near side. This sewing machine stitch is continued around the entire circumference of the vessel, using the same pieces of catgut or kangaroo tendon to splint it on each side. The method of Bickham is an eversion of the cut edges of the vessel, by means of a cobbler's stitch, using two fine needles on the same thread, as shown in Figure 13. Later, interrupted sutures unite the everted edges.

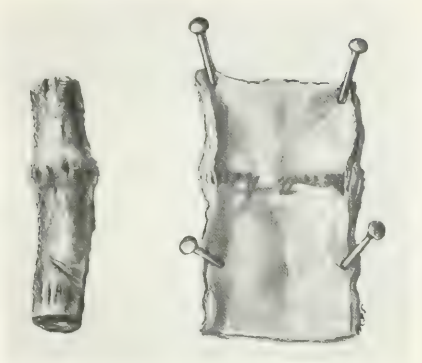


Fig. 18. The common carotid artery nearly 4 weeks after it had been resected and sutured by Carrel's method. There is thickening at the line of suture but no contraction nor dilatation. In the open specimen the sutures are covered by endothelium.

Lespinasse describes five different methods for use with his perforated rings of metallic magnesium. I shall describe only one, which seems to embody all of the features of the others and is the simplest. The rings are of pure metallic magnesium, flat, 1 millimeter

Fig. 19. Photomicrograph of a sutured common carotid artery, 4 weeks after operation. The endothelial cells have bridged across at the line of union (the depression) but there is no regeneration of the muscular or elastic tissues. The union has taken place entirely by fibrous tissue formation. Fragments of silk may be seen in the open space to the left. The dark area below the depression is round cell infiltration in the adventitia. (45 diameters.)

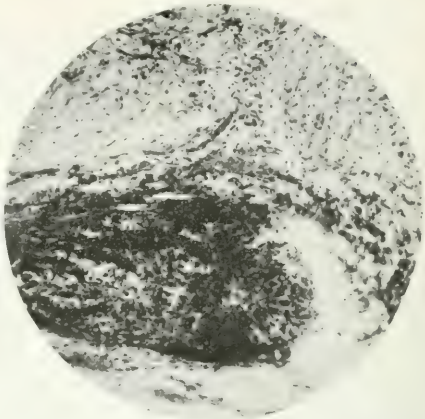


Fig. 20. High power photomicrograph of the same specimen. It shows that the union has taken place entirely by fibrous tissue formation, and that there is no regeneration of the muscular or elastic tissue. The dark area is round cell infiltration in the adventitia. (110 diameters.)

thick and from 1 to 2 millimeters in width. The rings vary in size according to the size of the arteries on which they are to be used. Each ring has 8 perforations. The technique here described is method III. A ring of appropriate size is slipped over each end of the vessel and secured to the latter by four equidistantly placed silk sutures, passing through every second perforation and through the entire thickness of the vessel wall, as near the edge as possible. These may be used as guy ropes. These sutures, when tied, with the knots at the edges of the rings, will evert the vessel ends and produce the condition shown in Figure 14. The next step is to pass a mattress suture, first through the ring and vessel edge on one side, with the guy rope, then through the corresponding perforation in the opposite ring, carrying the corresponding guy rope; then backward through the next perforation in the ring between the guy ropes, picking up the edge of the vessel, over to the other side, through the opposite edge of the vessel, and lastly through the corresponding perforation in the other ring. Four of these mattress sutures are passed in the same way and when tied, bring the everted ends of the two segments in accurate approximation, endothelial surface to endothelial surface. Finally the mattress sutures are cut short and the operation is complete. The metallic magnesium is ultimately absorbed. The technique is rather difficult to describe, but is readily understood from the illustrations (Fig. 14).

The disadvantages of all these eversion methods is that the lumen is necessarily narrowed at the line of union, and the operation rather difficult and prolonged. It is well to remember that we are not dealing with large tubes but rather with small ones, which require very careful handling and all manipulations are, therefore, of necessity very fine and delicate.

The method of Glueck, as shown in Figure 15, is no longer used. He united the segments end-to-end, with interrupted sutures, not penetrating the endothelial coat, and reinforced the line of suture with an isolated segment of artery or vein, or a cylinder of decalcified bone, ivory or rubber, which had

been previously slipped over one end and, after the sewing was completed, pulled over the line of suture. As I have said before, the method is obsolete.

Payr used thin cylinders of metallic magnesium, in which a groove was sunk toward one end. They were of various sizes to correspond with different sized arteries. The technique was to slip an appropriate sized cylinder over the proximal end of the severed vessel, with the grooved end toward the edge (Fig. 16). The end of the artery was then everted over the cylinder and a fine silk ligature was tied around it, either over the groove or back of it. Now the distal segment was drawn over the proximal everted segment and another ligature tied around it over the position of the groove (Fig. 16). As will be seen, this operation is a combination of eversion and invagination and has the disadvantages of using too much vessel, of narrowing the lumen at the site of anastomosis, and of having a foreign body around the vessel. Magnesium absorbs slowly with the evolution of hydrogen. To be sure, the gas is usually not a disadvantage, but it is certainly not an advantage.

So much for end-to-end anastomosis. As regards the repair of lateral wounds of the vessels, the technique is exactly the same only applied differently. One may use Carrel's method, the suture passing through all of the coats, beginning about $\frac{1}{16}$ inch from one end and terminating the same distance beyond the other end. Smith's sewing machine stitch may also be used, splinting the interrupted or continuous sutures on both sides with catgut or kangaroo tendon, thus producing an eversion of the wound edges. Lespinasse has devised perforated plates of metallic magnesium which are used with mattress sutures of fine silk, as shown in Figure 17. Carrel's method is the best, as it produces the least constriction of the lumen.

## VI. THE PROCESS OF HEALING OF AN ARTERY OR A VEIN AFTER IT HAS BEEN REPAIRED OR ANASTOMOSED

Figure 18 shows the common carotid artery of a dog 4 weeks after it had been resected and united, end-to-end, by Carrel's method. The section of artery has been removed and split open. As will be seen there is a marked thickening at the line of suture and, on the inside, the sutures of black silk may be seen covered by endothelium. There is no clot formation anywhere and the lumen is not constricted nor dilated. Microscopic examination of this and many other specimens show that the union is accomplished entirely by fibrous tissue formation between the ends of the vessel (Figs. 19 and 20), and that there is no regeneration of the muscularis or the elastic layers. The only tissue that does regenerate is the endothelial lining which quickly bridges over the gap and covers the sutures if they are exposed in the lumen. There is only one thing that prevents this endothelial proliferation and, in turn, causes thrombosis after a properly performed operation, and that is infection.

Infection of the wound may be entirely superficial, and not involve the deeper structures and vessels, as was shown in Experiments 15 and 16. In the majority of cases, however, where infection does take place, it extends deeper than the surface and produces an intravascular thrombosis.

## VII. CONCLUSIONS

I have done a considerable amount of experimental work on the larger blood vessels, particularly along the lines of gradual occlusion and vessel suture. Below I give a tabulated list of 19 vessel suture experiments, with conclusions. I have done many other experiments which are not included in the tabulation, because the methods tried were entirely unsatisfactory or because the records were incomplete. For instance, I have tried resection of the arteries, with end-to-end anastomosis by means of the "baseball" stitch, the sutures placed as closely together and as accurately as possible. This method is absolutely impracticable, in my opinion, because the alternating eversion and inversion, produced by this stitch, permits of too much hæmorrhage after the clamps have been removed, and very little real approximation of the edges of the vessel ends. I have also used a number of different suture materials, not noted in the tabulation, for example, silk,

TABLE I. VESSEL SUTURE EXPERIMENTS

| No. | Animal | Vessel Sutured | Type of Suture | Method | Time from Operation to Examination | Thrombosis | Constriction of Lumen | Course of Healing Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | Dog 24 lbs. | Rt. common carotid. | End-to-end, 1/8 inch resected. | Carrel looped stitch. | 3 weeks. | Yes. | Yes. | Primary union. |
| 2 | Dog 35 lbs. | Rt. common carotid. | End-to-end, 1/4 inch resected. | Carrel simple. 3 guy ropes. | 26 days. | No. | No. | Primary union. |
| 3 | Dog 28 lbs. | Rt. common carotid. | End-to-end, 1/4 inch resected. | Carrel simple. 3 guy ropes. | 17 days. | No. | No. | Primary union. |
| 4 | Dog 13 lbs. | Rt. common carotid. | End-to-end. | Carrel simple. 3 guy ropes. | 12 days. | Yes. | Yes. | Primary union—Clot shows no growth. Dog of longer vessel was very small. |
| 5 | Horse 750 lbs. | Rt. common carotid. | End-to-end, 3/4 inch resected. | Carrel simple. 3 guy ropes. | 5 weeks. | No. | No. | Primary union. |
| 6 | Horse same as 5 | Internal jugular vein. | Longitudinal cut in vein, 1 in. | Simple over and over stitch. | 5 weeks. | No. | No. | Primary union. |
| 7 | Dog 75 lbs. | Rt. common carotid. | End-to-end. | Murphy's invagination method. | 20 days. | Yes. | Yes. | Primary union—Artery at line of union united perfectly. |
| 8 | Dog same as 7. | Left common carotid. | End-to-end. | Carrel. | 20 days. | No. | No. | Primary union. |
| 9 | Dog 42 lbs. | Rt. common carotid united to rt. external jugular. | End-to-end. | Carrel. | 18 days. | No. | No. | Primary union. Proximal end of artery to distal end of vein. |
| 10 | Dog. same as 9 | External jugular united to rt. common carotid. | End-to-end. | Carrel. | 18 days. | No. | No. | Distal end of common carotid united to proximal end of ext. jugular vein. |
| 11 | Dog 45 lbs. | Rt. common carotid. | End-to-end, 1/4 inch resected. | Murphy's invagination method. | 3 weeks. | Yes. | Yes. | Primary union. |
| 12 | Dog same as 11 | Left common carotid. | End-to-end anastomosis. | Carrel. | 3 weeks. | No. | No. | Primary union. |
| 13 | Dog 100 lbs. | Rt. common carotid. | End-to-end, 1/4 inch resected. | Eversion — 9 interrupted sutures. | 6 days. | Yes. | Yes. | Dog died after 6 days, cerebral anaemia. Primary union. |
| 14 | Dog same as 13. | Left common carotid. | End-to-end, 1/4 inch resected. | Murphy's invagination method. | 6 days. | Yes. | Yes. | As above. |
| 15 | Dog 48 lbs. | Rt. common carotid. | End-to-end, 1/4 inch resected. | Eversion 3 guy ropes and continuous everting stitch. | 6 weeks. | No. | No. | Superficial infection only. |
| 16 | Dog same as 15 | Left common carotid. | End-to-end, 1/4 inch resected. | Eversion as in dog No. 15. | 6 weeks. | No. | No. | See above—No. 15. |
| 17 | Dog 42 lbs. | Rt. common carotid. | End-to-end, 1/4 inch resected. | Eversion—6 interrupted sutures and running stitch one-half way around to control bleeding. | 33 days. | No. | No. | Primary union. |
| 18 | Dog same as 17 | Left common carotid. | End-to-end, 1/4 inch resected. | Eversion — 3 guy ropes; continuous everting circular stitch. | 33 days. | No. | Yes. | Primary union. Constriction not attained at closed. |
| 19 | Dog 42 lbs. | Left common carotid. | End-to-end, 1/4 inch resected. | Carrel. | 33 days. | No. | No. | Primary union. |

linen, human hair, horse hair, very fine bronze wire and catgut. I have found that fine silk answers the purpose better than anything else. It can always be procured, is fine, strong, and is easily handled. I have used curved needles as well as straight ones and am convinced that the straight ones are better because they are always at hand and can be used without a needle holder. The sewing machine needle method or any other based on this principle, has no place in vessel suture, as it complicates an otherwise simple procedure.

I think that I have now set forth and made clear my opinion in regard to the very simple, but supposedly very complicated operation, of the suture of arteries and veins.

The tabulation of experiments and conclusions follow:

SUMMARY

| | | |
|---|---|---|
| End-to-end anastomosis—17 cases | | |
| Carrel method—9 cases | | |
| Not thrombosed | 7 cases | 78 per cent |
| Thrombosed | 2 cases | 22 per cent |
| Eversion method—5 cases | | |
| Not thrombosed | 4 cases | 80 per cent |
| Thrombosed | 1 case | 20 per cent |
| Murphy method—3 cases | | |
| Not thrombosed | 3 cases | 100 per cent |
| End-to-side anastomosis—2 cases | | |
| Not thrombosed | 2 cases | 100 per cent |
| Arteriovenous anastomosis—2 cases | | |
| Not thrombosed | 2 cases | 100 per cent |
| Lateral longitudinal wound in vein —sutured—1 case | | |
| Not thrombosed | 1 case | 100 per cent |

One dog died of cerebral anæmia, as a result of both arteries becoming thrombosed. Experiment 8.

There was superficial infection of wound in Experiment 13. The infection did not extend to the artery.

There was marked narrowing of the vessel in Experiment 18.

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# THE DIAGNOSIS AND SURGICAL TREATMENT OF TUMORS IN FRONT OF THE SPINAL CORD[1]

By CHARLES A. ELSBERG, M.D., F.A.C.S., New York

TUMORS that grow on the anterior surface of the spinal cord—whether they are extradural or intradural—give rise to symptoms which are often difficult to differentiate from intramedullary growths. For this reason surgical interference is often delayed until marked cord symptoms have appeared. Furthermore, the exposure and removal of these anterior tumors is often difficult. After the surgeon has performed the laminectomy and has incised the dura, he must draw the exposed part of the cord over to one side in order to expose and extirpate the growth. Even when the manipulations are carried out with gentleness and care, the danger of injury to the delicate cord tissue is very great.

It is important, therefore, that the diagnosis of spinal cord tumors in this location should be made as early as possible, and it is equally important that the surgical procedure for the exposure and removal of the growth shall be one that will reduce to a minimum the dangers to the delicate cord tissue.

About 10 per cent of extramedullary spinal tumors are located anteriorly and anterolaterally to the spinal cord. As the dentate ligament forms the boundary between the anterior and posterior halves of the cord, any tumor that develops in a location anterior to the plane of the dentate ligament must be considered as lying on the anterior aspect of the cord. If, however, the growth lies in front of the dentate ligament—between it and the anterior spinal roots—its location is, more strictly speaking, on the anterolateral aspect of the cord. On the other hand, all growths that lie in front of one or more anterior spinal nerve roots, no matter whether they are mesially or laterally placed, are true anterior growths. Frazier has collected 330 cases of spinal cord tumor, in 35 of which (10.6 per cent) the growth lay on the anterior or anterolateral aspect of the cord. In 9 of

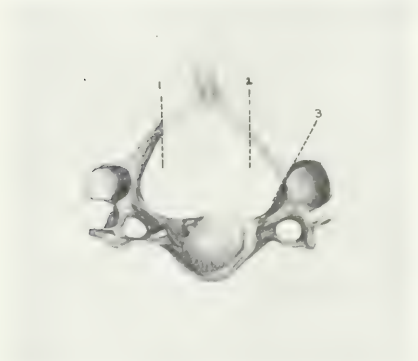


Fig. 1. A cervical vertebra, showing, 1–2, the amount of bone to be removed for an ordinary laminectomy, and, 1–3, the amount to be removed for the approach from the right to a tumor in front of the cord.

Fig. 2. A dorsal vertebra, 1–2, the ordinary laminectomy; 1–3, laminectomy for approach of tumor in front of cord from the right.

Primary and secondary malignant growths of the backbone (vertebræ and sacrum) excluded

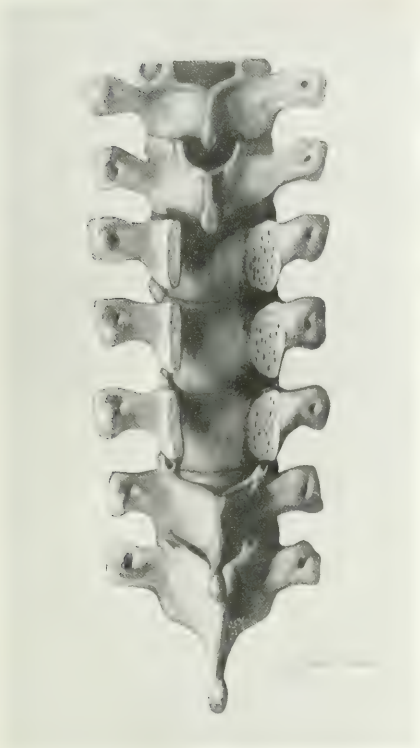

Fig. 3. The amount of bone to be removed in a laminectomy for approach, from the right side, to a tumor in front of the spinal cord.

82 spinal tumors that I have operated on, the tumor developed in front of the cord (10.9 per cent).

These anterior growths usually have a painless beginning. Muscle atrophies are often the first sign of the disease. When the tumor is located in the lower cervical region, the first symptom may be an atrophy of the small muscles of the hand on the one or the other side. If the patient is examined in this stage, there may be few or no sensory disturbances, and when signs of sensory loss do appear, the patient is apt to notice first a disturbance in

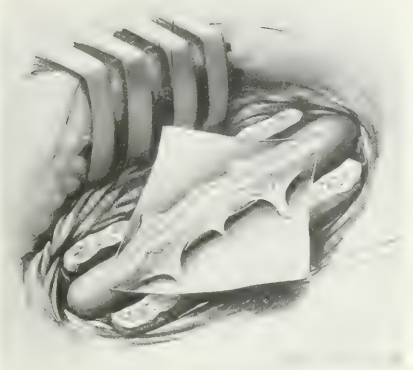

Fig. 4. The spinal cord pushed backward by a tumor in front of the cord.

feeling in the lower limbs. I have seen a number of cases of tumor of the spinal cord located anteriorly, where the patients had for a number of years, an increasing spasticity of the lower limbs without sensory loss in any part of the body. We have learned to suspect an anterior spinal cord tumor in any patient who has an increasing spastic paraplegia without or with only indefinite sensory disturbances.

The sensations of pain and temperature may be disturbed first and the whole clinical picture—muscle atrophies with dissociated sensory disturbances—may be that of an intramedullary disease. Sooner or later, however, all types of superficial and deep sensibility become affected.

In syringomyelia and in intramedullary growths sensory disturbances usually appear first, and precede the muscle atrophies. In the early stages of intramedullary disease, it is often difficult to determine the upper level of the lesion. As Head has repeatedly emphasized the upper areas of disturbed sensibility often shade very gradually into those of normal sensation. Besides, an upward shifting of the level signs is not rare in intramedullary disease; in anterior spinal newgrowths, however, the level signs remain constant. As I have already stated, in these anterior growths level signs may be wanting

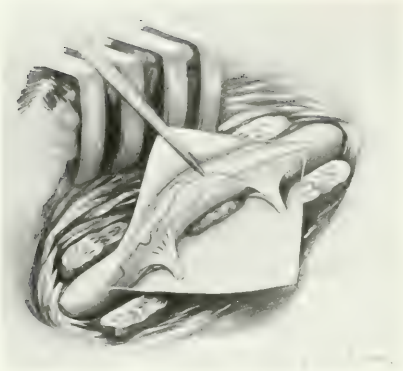

Fig. 5. Partial exposure of tumor in front of the cord by traction on a slip of the dentate ligament.

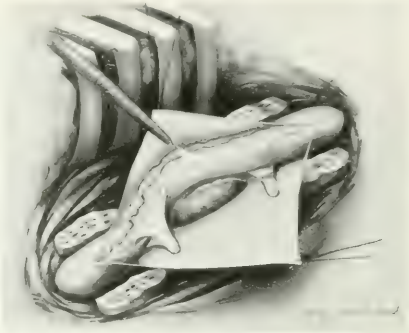

Fig. 6. Complete exposure of a tumor in front of the cord by traction on a slip of dentate ligament after division of one posterior root.

for a long period of time, but when sensory level signs begin to appear, they increase with considerable rapidity. A patient who had previously had only indefinite signs of a local spinal lesion may within a few weeks or months develop perfectly characteristic signs of a local spinal cord compression.

### REMOVAL OF GROWTHS IN FRONT OF SPINAL CORD

The operative procedures may be either intradural, extradural, or transdural, depend-

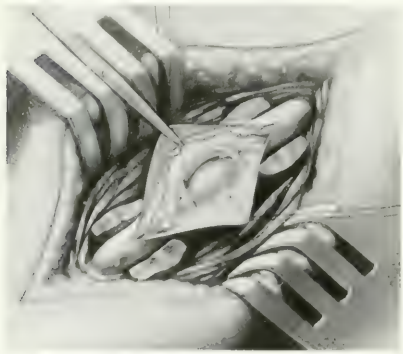

Fig. 7. Removal of extradural tumor by the transdural route. Exposure of tumor in front of the spinal cord.

ent upon the location and the size of the growth. The exact location of the growth can, in many instances, be determined only after the dural sac has been opened.

For the removal of these anterior tumors the removal of the laminæ of the vertebræ must be extensive.

After the tumor has been located, the laminæ must be rongeured away on one side down to the transverse processes. In the cervical region the wide removal of the laminæ on one side (Fig. 1) will be sufficient to allow of a direct anterior approach to the growth. In the dorsal regions the base of the transverse processes on one side must often be removed (Fig. 2 and 3).

In intradural growths, the method of procedure is the following: After the dura has been incised and the growth located, a slip of the dentate ligament, on the side from which the tumor is to be approached, is grasped with mosquito forceps, the slip cut free from its attachment to the inner surface of the dura, and traction made on the forceps. By this means, the spinal cord is raised out of its bed, drawn to the other side, and partly rotated (Figs. 4 and 5). If the growth is not sufficiently exposed, especially if it lies in front of the cord near the mid-line, the corresponding posterior root may have to be divided. As soon as this has been done, the cord can be still further pulled to one side

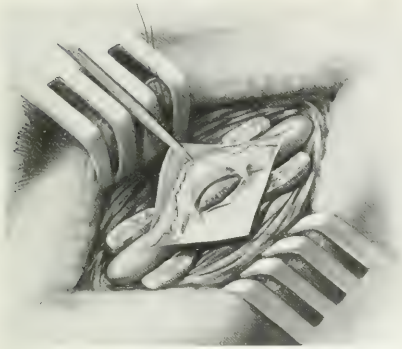

Fig. 8. Removal of extradural tumor by the transdural route. Incision of the anterior layer of the dura and exposure of the tumor.

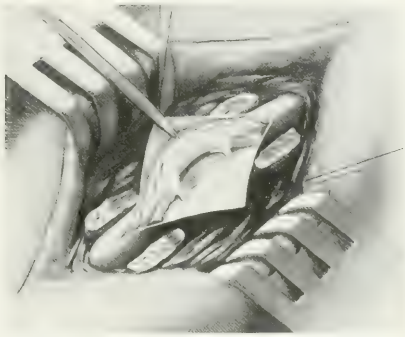

Fig. 9. Removal of extradural tumor by the transdural route. Condition after removal of the tumor.

(Fig. 6). These procedures usually suffice to bring the entire tumor into view. During its removal, the retraction of the cord is continued by an assistant, and the operator proceeds with the extirpation of the growth by working from the mesial aspect of the growth toward the side, i. e., in a direction away from the spinal cord.

If the tumor is found to be an extradural one, one of two methods should be followed. The entire dural sac may be drawn to one side and the tumor thus exposed. In this procedure the bleeding from the veins on the posterior surfaces of the bodies of the vertebræ may be profuse and very disturbing, and the manipulations necessary for the control of the oozing (packing, etc.) may mean considerable pressure upon the cord through the dura, especially if the tumor lies near the mid-line in front of the dural sac and cord. In these cases, I have performed a transdural operation and have found it very applicable to extradural tumors in this location.

The steps of the procedure are the following: After the dural sac has been opened and the cord drawn to one side in the manner I have described, the anterior layer of dura is freely incised and the growth thus exposed and removed. The edges of the incision in the anterior dura are then allowed to fall together without any sutures (Figs. 7, 8, and 9).

From my experience, I can highly recommend this transdural approach as one that will endanger the cord less than the extradural procedure. The method is also useful for the removal of a process of bone remaining after a fracture of the spine and projecting backwards from the body of a vertebra.

# SOME NOTES IN REGARD TO THE SURGERY OF SOUTH CHINA[1]

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Surgeon, Canton Hospital

THE following statements concerning the incidence of surgical diseases and conditions are based upon an analysis of 64,938 operative procedures performed upon inpatients in the Canton Hospital during a long term of years and the other data from the records of 13,761 operations performed upon inpatients in the same institution during the past 10 years. Brief notes in regard to a few interesting cases are also added.

The following was the order of frequency in the incidence of disease as affecting the different systems: ophthalmological, 18,734 or 26.7 per cent of the cases; infections, 13,616 or 19.4 per cent; genito-urinary, 11,190 or 16 per cent; tumors, 5,184 or 7.4 per cent; wounds and injuries, 4,743 or 6.7 per cent; bones and joints, 4,526 or 6.4 per cent; digestive, 3,655 or 5.5 per cent; upper tract, 926 or 1.3 per cent; abdomen and wall, 292 or 0.4 per cent; rectum and anus, 2,527 or 3.6 per cent; congenital abnormalities, 2,410 or 3.4 per cent; otological, 2,063 or 2.9 per cent; obstetrical, 1,599 or 2.3 per cent; gynecological, 737 or 0.7 per cent; lymphatic, 464 or 0.6 per cent; circulatory, 234 or 0.3 per cent; rhinological and laryngological, 155 or 0.2 per cent; respiratory, 48 or 0.07 per cent; ductless glands, 11 or 0.01 per cent. During the past 8 years the hospital work has been specialized.

*Congenital abnormalities.* Phimosis, 1,123 cases; hare-lip, 856; imperforate anus, 230; polydactylism 46; nævi, 34; cleft palate, 14; hypospadias and epispadias, 14; vaginal atresia, 12; webbed fingers, 10; branchial cysts, 7; cephalomengocele, 3; rectovaginal cloaca, 5; patent urachus, 3; teratomata, 3. Patients with hare-lip usually come to the hospital just prior to marriage. The average age for the males with this condition was 21, females 14. A male child, 3 years of age, presented a channel from the bowel, along the inferior surface of the penis, and parallel with the urethra, which gave exit to the fæces at the end of the penis just below the meatus urinarius. A boy with imperforate anus had a canal along the scrotum to the middle. A lower incisor was extracted from a baby 7 days old. One boy was operated upon at the same time for hare-lip, supernumerary thumb, and ear. In one case the radius of both forearms and the thumbs of both hands were wanting. A patient who was almost blind lacked all fingers except the thumbs and little fingers. There was a corresponding deficiency in the feet. The metacarpals and metatarsals were also wanting, except in the case of the little toe of the right foot which had two metatarsals. Another patient lacked all of the part of the right foot anterior to the ankle, there being a deficiency of 25 bones, and of all of the ligaments, muscles, vessels, and nerves. A boy of 7 had his right temple, cheek, and side of his nose covered with a thick growth of hair several inches in length. A child resembling a monkey lived for 10 hours. The face, body, and limbs were well developed. The head receded from the eyebrows backward and downward. The top of the head was flat with an oval space of ulcerated skin with an opening in the bone exposing the foramen magnum and the base of the skull around it. The frontal, parietal, and occipital bones rested on the base of the skull. The spinal column terminated abruptly at the foramen magnum. Only rudiments of the cerebrum and cerebellum existed. Transverse diameter at zygoma, 1.1 inches. Parietal bones, 2. Anterior posterior, 2.6 inches diameter. A boy of 9 had seven toes to each foot, the supernumerary ones being on the inner side of his feet. Both tibias were dislocated at the knee-joints and the upper ends projected obliquely outward, while the shafts were somewhat curved, with the lower ends projecting inward, throwing the soles of the feet inward and upward. The thumbs of both hands were wanting. Imperfect thumbs were attached in their whole length to the inner sides of the index fingers.

[1] Presented at Clinical Congress of American College of Surgeons, Montreal, October 11, 1915.

Fig. 1.

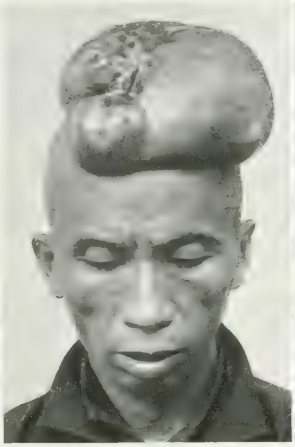

Fig. 2.

Fig. 3.

Fig. 1. Sarcoma of the eye. Removed.
Fig. 2. Sarcoma, recurrence.
Fig. 3. Lipoma in boy, age 11. Duration 9 years. Removed. Weight 4 pounds.

*Locomotor.* Caries, 2,401; amputations, 667; fractures, 666; dislocations, 469; arthritis, 215; supernumerary digits, 46; gangrene, 36. Tuberculosis of the bones and joints is usually seen between the ages of 10 and 20. Sequestra of from 3 to 5 inches in length were removed from the shafts of the bones of a number of children, usually boys. In most cases the fistulæ promptly heal. In one case the left clavicle which was necrosed, stood out as a bridge, denuded of skin and only attached at the ends. A patient was admitted with an ulcer which refused to heal; a piece of bamboo 3½ inches long, sharp at one end and ½ inch wide at the other, of the presence of which the patient was not aware, but which must have been there for a year, was removed. Gangrene of the feet from compression was sometimes seen. Cases in which the gangrene extended to the ankle, knee, hip, and elbow were treated. Sometimes the limb has already sloughed off.

*Circulatory.* The larger arteries were ligated 140 times, 34 for aneurism. There were 58 aneurisms, a few successfully cured by endo-aneurismorrhaphy; 34 angiomata; 6 varicose veins. This is quite a common condition, but as it does not cause pain or disability, operation is not desired. Two tumors of the carotid body were excised. One patient had an aneurism of the thoracic branch of the axillary artery, external to the ribs, extending from the clavicle to below the nipple and from the axilla to the sternum. This condition is most frequently seen in males, and at the average age of 38.

*Digestive, upper tract.* Thirteen ranulas; epulis, 32; cancer of the lip, 10; cancer of the tongue, 5 (many cases seen are inoperable); foreign bodies in the œsophagus, money, false teeth, bones, 10; stricture of the œsophagus, 3. Interference with the functions of mastication, deglutition, and respiration usually impels the patient to come to the hospital sooner or later. The causes may be a large fibroma of the upper lip, macroglossia filling and extruding from the mouth, bony ankylosis of the maxillæ, sarcoma of the superior maxilla which usually distends the cheek and completely fills the mouth so that the jaws cannot be closed, with displacement of the nose and mandible. The antrum may be cystic and

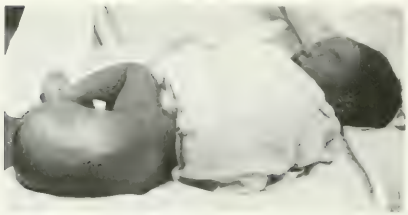

Fig. 4. Congenital tumor, patient 1 day old. Removed successfully.

greatly distended or a large polyp in the antrum may be the cause. Tumors of the inferior maxilla, odontoma, osteosarcoma, cyst, or necrosis with abscess may be the cause. Multiple polyps, so large as to cause absorption of the nasal and submaxillary bones and bulging of the face and to fill the posterior pharynx, may become malignant.

*Abdomen and wall. Hernia.* Inguinal, 74; ventral, femoral and labial, 26; traumatic, 8; appendicits, 30; liver abscess, 34; acute general peritonitis, 10; tubercular peritonitis, 16; splenectomy, 5; intestinal obstruction, 7; intra-abdominal abscess, 5; carcinoma of the stomach, 5; tubercular adenitis, 3; gastro-enterostomy for gastric ulcer, 2 (this condition is fairly common, but the patients are cured by the physician); incised and stab wounds, 20; foreign bodies extracted, 18; fœcal fistulæ, 16; a few cases of adhesions; one cyst of the mesentery; intussusception, 2. In 43 exploratory laparotomies the condition was found to be inoperable. In many cases it does not require an operation to determine this. Gunshot wounds of the abdomen are frequently treated, usually late, often exsanguinated. The average age of the patients with inguinal hernia was 35 years. In a case of ventral hernia complicated with ascites and diseased ovaries, the hernia extended half way down to the woman's knees. To relieve his suffering a man with strangulated hernia made a deep vertical incision with a razor which divided the transverse colon for three-fourths of its circumference. A few cases of fæcal fistula secondary to hernia, usually in males, about 35 years of age, were treated, and there were several cases of this condition resulting from congenital hernia, umbilical and inguinal. A female patient had incarcerated inguinal hernia. A woman of 40 had a wide deep ulcer in the left iliac region. She reported that native medicine men had applied medicines for one month, after which a worm over 10 inches in length came out. Cutting open the belly with a piece of porcelain, more than one hundred little worms came out. The ulcer then closed.

*Rectum and anus.* Fistula-in-ano, 1,073; hæmorrhoids, 1,101; imperforate anus, 230; stricture of the rectum, 67; prolapse, 45; cancer, 9; one polyp. In one case a native physician was applying ointment with a large stick which slipped into the rectum. A large club was forced into the rectum of one patient as a punishment for adultery.

*Genito-urinary.* There were 3,500 operations for calculus of the urinary organs, of which 2,970 were vesical, 409 urethral, 116 preputial, 5 renal; hydrocele 1,858; stricture of urethra, 1,045; chancroid and bubo, 610; cancer of the penis, 207; extravasation of urine, 93; orchidectomy, 39; elephantiasis, 81—scrotum, 31, 15 each of the penis and labia, and 8 of the leg; foreign bodies in the bladder, 18, including needles, catheter fragments, gauze, sticks; hypertrophied prostates, 6; malignant growths of the bladder, 6; tubercular bladders, 4, 2 of which were ruptured; papillomata, 3; many gunshot wounds; 15 kidneys were decapsulated with temporary relief of symptoms. The cases of malformation of the penis are usually brought to the hospital at puberty. Venereal diseases are most common among soldiers and the leisure class. Gonorrhœa, primary and secondary syphylis, and chancroid and bubo are usually seen in both males and females between the ages of 25 and 30 and stricture at 40. A patient with calculus impacted in the urethra had retention for 7 days; 1½ gallons of urine and pus were removed. A male, aged 63, with phimosis from infancy had 40 preputial calculi. One calculus contained a portion of a beanstalk 6 inches long, introduced by mischievous boys while he was asleep. A boy introduced a needle 2 inches long into his urethra; it slipped into his bladder, and formed the nucleus for a stone.

One calculus, 3 by 1 inch was bent to a right angle. A male, 24 years of age with a 12-ounce stone had symptoms for over 20 years. A farmer had lithotrity performed upon him five times. A boy of 7 had his bladder divided by a septum into two compartments, each of which contained a stone. Another with 10 years' duration of symptoms, had two calculi in the urethra. The bladder was divided into two cavities by a septum, with a stone in the anterior one. Thirty stones were contained in a sac below the neck of the bladder, and a single one in the bladder in another case. One patient had a stone in a urinary fistula and another one in the bladder. A patient with a 10-ounce stone had marked kyphosis. A brass ring which had been buried in a ulcer for 10 days was removed from around the penis of a boy. In a case of syphilis the penis was entirely gone and there was a large opening into the bladder.

*Glandular.* Three hundred and eighty-three cases of tubercular adenitis, usually cervical, went to the operating table for block dissection. Of goiters, there were 8 parenchymatous, 1 exophthalmic, and 1 with abscess. In the adjoining province this condition is very common. Most of the cases we see are intrathoracic.

*Infections.* Abscesses, large, 10,874; ulcers, 2,647; carbuncles, 70.

*Respiratory system.* Twenty-one cases of empyema, usually due to gunshot wounds; 4 of abscess of the lung. Eight cases required tracheotomy, 1 laryngotomy.

*Tumors.* There were 5,184 tumors, including 525 cases of carcinoma of the breast, 17 neuromata, and 3 teratomata. Seventy per cent were benign and 30 per cent malignant. A male of 40 had a large tumor, shaped like a violin, attached to his shoulder, with circumference at the base of over 3 feet, length of 2 feet, and width of nearly 2 feet. He spent most of the time reclining upon his tumor. Another presented himself at the hospital with a tumor attached to his back and extending nearly to the ground. It was over 4 feet in circumference and probably weighed from 75 to 100 pounds. When he sat down it formed a large circular cushion that elevated him 8 inches. It was proposed to remove it,

Fig. 5. Congenital tumor. Removed.

but his idol, which he consulted, decided against it. A young woman had a tumor attached to the chin and throat, more than 2 feet in circumference which weighed 16 pounds. A male of 50 presented lipomata of both cheeks of the same size, about 10 inches in circumference, hanging pendulous. A male of 49 was covered from head to foot with molluscum fibrosum, from the size of a pea to one foot in circumference. In the case of a woman with elephantiasis of the vulva of 10 years' duration, the mass hung half way to the knees. A farmer, 41 years of age, had an enchondroma, 1 foot in circumference, forming a perfect sphere, surrounding the middle finger of the left hand. Patient had tumor of the foot, which had grown for 10 years, covering most of the dorsum of the foot and passing to the plantar surface, between the first and second metatarsals, separating the toes for 2 inches. A female of 38 had a tumor of the breast of 10 years' duration weighing over 9 pounds. A male of 43 had cancer of the breast, duration 1 year. A male patient had a tumor of the median nerve the size of an orange. A female, 45 years of age, had a cauliflower-like tumor attached to and growing out of the nipple, which had dragged down the breast until it was suspended by a long pedicle reaching below the umbilicus. A male of 33 had hypertrophied cavernous bodies, which had commenced to grow when he was 6 years of age. The enlargement was 4 inches in diameter. The patient was married but never had erections, emissions, or children. A

Fig. 6. Elephantiasis of the vulva. Removed.

teratoma weighing about 5 pounds, with length of 12 inches and greatest circumference 17 inches consisted of a fœtus in which the development had been arrested early in the fifth month of intra-uterine life. A broad attachment to the living child extended from the anterior portion of the trunk.

*Wounds and injuries.* Gunshot wounds, 1,380; incised and stab wounds, 364; burns and scalds, 313; foreign bodies extracted, 323, including 100 needles, 27 bamboo sticks, and 26 miscellaneous articles such as rings, catheter fragments, coins, bones, gauze, sticks; from the eyelid, hand, finger, œsophagus and trachea, bladder, uterus, rectum, stomach, colon. Three hundred and thirty-nine bullets were extracted. There were 42 powder burns. Eight patients were gored by water buffaloes. Ten were bitten by snakes, dogs, pigs, and human beings. One was clawed by a tiger. There were 97 bomb wounds.

*Gynecology.* Three hundred and sixteen cases of ovarian adenocystomata were operated upon. There were also 6 ovarian dermoids, 6 parovarian cysts, and 3 papillomata of the broad ligament; 42 vesicovaginal fistulæ; perineorrhaphy (delivered outside) required in 91 cases; uterine fibroids, 25; prolapsus uteri, 22; salpingitis, 9; repair of lacerated cervix, 40; hydatid mole, 5; hysterectomy, 28; vaginal atresia, 12; pronounced retroverted uterus, 15; rectovaginal cloaca, 5; labial tumors, 5; carcinoma of vulva, 3. Ovarian cysts are seen in girls of 17 and women of 60, the average age being 30 years; abdominal girth from 35 to 72 inches; weight of tumors from 10 to 116½ pounds; duration of symptoms, when patient first noticed enlargement of the abdomen until admitted to the hospital, from 3 months to 20 years, average 3 years. A girl of 17 had a cyst which weighed 70 pounds, about a fourth of which was solid. No uterus was found in a girl with imperforate vagina. Several cases of bicornuate uterus were seen. A female of 21 had an abdominal tumor the size of an orange, situated 3 inches below the umbilicus in the mid-line. When 10 years of age she had noticed a lump in the abdomen which was movable. An abscess had formed and discharged large quantities of pus, flesh, and hair. Native doctors (so called) had applied caustics, making fistulæ which had also discharged pus, hair, and three teeth.

*Obstetrics.* Normal deliveries, 875; forceps deliveries, 432; version, 184; retained placenta, 114; craniotomy, 93; miscarriages, 52; placenta prævia, 33; transverse presentations, 16; twins and triplets, 7; cæsarean section, 5; ruptured uterus, 5; prolapse of uterus, 8; retroverted gravid uterus, 2. A female, 24 years of age, had malaria with ascites and was supposed to be dying; a coffin and shroud were therefore provided and placed by her bedside. Labor commenced, and she was brought to the hospital. An enchondroma had grown directly across the pelvis originating from the tuber ischii. Cæsarean section was performed and a 4½-pound girl removed. In a case of twin pregnancy, the first child had been born naturally; the arm of the second presented, the uterus ruptured and the child had partly passed into the abdominal cavity. It was necessary to remove a dead fœtus from the uterus of a woman with smallpox, covered from head to foot with scabs, who had not been cleaned since the commencement of her sickness 2 weeks previous.

*Ophthalmology.* Entropium, 12,585; cataract, 3,052; pterygium, 1,385; iridectomy, 1,091; enucleation, 140; glaucoma, 72; tumors of the orbit, 61; foreign bodies extracted, 52; hypopyon, 40; staphyloma, 37; strabismus, 19. A male of 60 with dimness of vision in the left eye presented a white spherical body with a tail-like appendage in the anterior chamber, which was found to be a hydatid. In an infant of 2 months, the inner half of both upper eyelids were wanting and pterygia

extended from both eyeballs to this part of the lids.

*Otology, rhinology, laryngology.* Nasal polyps, 641; tonsillectomy, 116; rent ears, 1,471; aural tumors, 32; radical mastoid, 8; occlusion of the nares, usually from smallpox, 20; sinusitis, 22. A sixteen year old boy was without an external ear or meatus.

Because of its spectacular results, surgery has made more rapid progress in the confidence of the people than medicine. During the past 10 years, although many advanced pathological conditions and inoperable cases are still seen, many more of operable abdominal conditions and acute cases have steadily been observed. Injuries from machinery and gunshot wounds, inflicted during the revolutions and by the ubiquitous robbers and pirates, and in clan fights are more frequently treated, and are brought to the hospital at earlier stages. Pain or serious disability usually drives the patient to the hospital. Many of the patients are afflicted with a variety of diseases and conditions, concomitant, or complications. The greater number are infected with intestinal parasites. Physiological standards for the Chinese people are being worked out.

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## DIVERTICULUM OF THE ASCENDING COLON

By R. O'CALLAGHAN, M.D., F.A.C.S., Calgary, Alberta

THE patient from whom this interesting tumor was removed was a female, age 68, married, and the mother of 7 children. Until 5 years ago she had always been healthy, and the menses had been normal. Five years ago patient was victim in a disaster in Halifax and received serious injuries consisting in contusions of the abdomen and body. She was very sick and was kept in bed for several weeks without any special treatment. Since the accident she has noticed a swelling in the abdomen which has seemed to come and go, appearing first in one place and then in another. She did not suffer pain and was not markedly constipated. She had not consulted a physician during these attacks. Two days before she called me, she was taken with sudden severe abdominal pain which was localized in the right lower quadrant; she vomited and was constipated. On the third day she became worse and because of a rise in temperature she decided to consult a physician.

*Physical examination* showed a well developed, somewhat obese adult, who looked sick and was propped up in bed. Her temperature was 102°; pulse 120. Her tongue was coated, teeth poor. Examination of heart and lungs was negative. The bowels moved just before the attack of pain 2 days ago. The abdomen was very fleshy and moved slightly on respiration. In the right lower quadrant a distinct fullness could be seen. On palpation the abdomen was slightly tender throughout but over the right lower quadrant, in the region of the tumefaction about the level of McBurney's point, a very acute tenderness was elicited. The mass was slightly movable, dull on percussion, and about the size of a fœtal head. On palpation it did not feel like an abscess but resembled rather a cyst or tumor.

Vaginal and rectal examination was negative, as the mass did not extend low enough to be palpated through these routes. The uterus was normal and moved freely.

Urinalysis showed specific gravity 10.18; albumin, acid reaction, pus, no blood. The kidneys were not palpable. To exclude floating kidney with pyonephrosis a bilateral catheterization was done. Both kidneys functioned well and only a small amount of pus and a trace of albumin was found in the urine from each.

Examination of the blood showed: white blood cells, 14,000; red blood cells, 4,800,000; polymorphonuclears, 80 per cent.

Enemata were given but produced no results.

From the above examination it was difficult to make a definite diagnosis. There appeared to be partial obstruction; the mass might be an ovarian growth with twisted pedicle or a malignant growth of the colon. We felt satisfied it was not an appendiceal abscess.

*Operation.* Through a long right rectus incision below the umbilicus, the abdomen was opened. We found some serous fluid in the cavity but no pus. The mass was soon located. At first, it resembled a cystic ovary. Only a small piece of it was visible but the remainder of it was found wrapped in the small intestine and omentum. After gradually separating the adhesions we found that the mass extended upward, not downward into the pelvic region. When separating the intestine from the mass with a sponge, the tumor collapsed with the noise of escaping gas. The mass proved to be a large obstructed diverticulum of the ascending colon. The latter was in itself very mobile and accounted for the changing position of the tumor. The

Photograph of specimen.

diverticulum evidently filled and emptied according to the patient's history and this accounted for the disappearance of the tumor at times. In the present attack it had evidently closed off at the base and became a sac of fæcal matter with gas causing partial obstruction, temperature, and general signs of toxæmia.

I removed the mass by placing a small clamp on the colon and resecting. The wound was closed in the usual manner without drainage. The patient made an uneventful recovery.

Pathological report by Dr. Leacock, pathologist, Holy Cross Hospital, Calgary: In gross appearance the sac removed from the bowel is of large pear shape. It is 13 centimeters long and 6 centimeters in width. The upper, larger, end is very thick walled and has a very thick fibrous opening about 2 centimeters in diameter at the extreme end. The lower, smaller end of the sac is thin walled and blind. The sac has been opened and contents have been evacuated. (It was said to be filled with fæcal material.) Specimen preserved.

Microscopic examination shows the wall of the sac composed of fibrous tissue and some loose connective tissue, with scattered areas of small round cells. No glandular layer is to be seen.

I feel that this case should be reported for, although diverticula are becoming more easily recognized, they are not usually found in the ascending colon. They are more often found in the sigmoid, transverse, and descending colons. The diverticulum in this case evidently followed directly on a severe injury to the abdominal wall, and there is a possibility that at that time the bowel wall partially ruptured.

It is quite conceivable that many of the men returned from overseas who suffered while there with symptoms of peritonism without any definite rupture, may later develop diverticula. In many cases also exploratory laparotomies were done and the intestines repaired; in others, abrasions or even ruptures were overlooked which of necessity must leave weak walls of the intestinal muscular coat. As Binnie points out in his *Regional Surgery* there are points of weakness in the muscular coats of the colon in many individuals and these points are often starting points for diverticula. Many cases of diverticulum of the colon are I believe explored under a diagnosis of malignancy of the colon. In this case such a contingency was naturally taken into consideration in the differential diagnosis although there had been no common symptoms of such and the patient showed no signs of cachexia or failing health that would be expected to be present in a malignant growth of that size.

# DISCONNECTING GASTRO-ENTEROSTOMY STOMATA

## A Clinical and Experimental Study[1]

By ROSCOE C. WEBB, M.D., F.A.C.S., Minneapolis, Minnesota
Associate Surgeon, University Hospital
From the Department of Surgery of the University of Minnesota

THE gastro-enterostomy operation is today so thoroughly standardized that it has become, in the hands of one experienced in surgical technique, to be considered a relatively safe procedure. When indicated, this operation gives very satisfactory results and is given much well deserved praise. However, the extensive use of this form of treatment has occasionally led to its abuse, and today in every large surgical clinic cases appear in which we find that at some previous time a gastro-enterostomy has been done, that there has not been a relief of symptoms, or that the condition of which the patient was complaining has been made worse, and the patient desires to have the previous operation undone. After considerable careful study it may finally be found that there was no indication for the operation in the first place and the patient is submitted to a second operation in order to give relief. Occasionally it is only at the second operation, after caretul exploration of the stomach, that one can finally decide that the first operation was not indicated and the gastro-enterostomy must be disconnected.

The patient usually presents symptoms of a vicious circle with continuous and frequent vomiting of bile-stained material, and abdominal pain and distress. There seems to be no non-operative relief for the condition.

There are numerous methods used in disconnecting these cases, but there is as yet no standardized procedure. The chief questions are, first, the restoration of the organs to their normal position and mobility with as few adhesions as possible, and second, the prevention of constriction of the lumen of the jejunum. The stomach is capable of taking care of itself provided it is disconnected, released from adhesions, and properly closed. The care of the jejunum is left for consideration. If the disconnecting incision is made along the line of the anastomosis there will be a certain amount of constriction of the jejunum due to the fact that there is a loss of tissue with every intestinal anastomosis. This loss of tissue consequent to the first operation reduces the circumference of the jejunum at this point and when it becomes necessary to invert the jejunum at this point again, as a result of the operation of disconnecting the gastro-enterostomy, the stricture at this point may become serious. For this reason various methods have been suggested for preventing stricture. The method which has seemed most feasible and which has been tried out clinically and experimentally at the University of Minnesota is the method briefly described by Andrews,[1] as follows: After lifting the transverse colon and exposing the line of union to the bowel, the rubber-covered clamps are placed on each viscus, leaving a free space for operation. The incision is made upon the stomach wall 1 centimeter away from the line of anastomosis, leaving a cuff of stomach entirely around the false opening in the bowel. When the jejunal opening is closed there is just enough to bring the bowel to its normal diameter when two or three rows of inversion sutures have been placed. The stomach opening is closed by the usual method and the loss of tissue is of no consequence. The opening in the transverse mesentery is closed to prevent any possible hernia and the operation is completed.

The method has been tried and in three cases proven satisfactory clinically, two cases at the University Hospital and a third case kindly reported to me by Dr. Ritchie of St. Paul, which are briefly reported, as follows:

Case 1. Mrs. F. N., white, housewife, age 23 years, was admitted to the University Hospital March 12, 1920, complaining of inability to retain food, nausea, vomiting, loss of weight, and abdom-

[1] E. Wyllys Andrews: Disconnecting Gastro-enterostomy Stomata. Tr. Am. Surg. Ass., 1920, xxxviii, 628.

[1] Read before the Clinical Club of Minneapolis, April 21, 1921

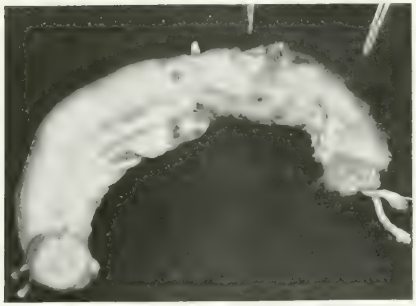

Fig. 1. Dog. Experiment 1. Photograph of distended specimen, fresh. The instruments point to the ends of the closed stoma. Note absence of constriction.

Fig. 2. Experiment 1. Photograph of fresh specimen cut longitudinally opposite to the closed stoma. Note the gastric mucosa surrounded by jejunal mucosa.

inal tenderness. Her family history has no bearing on the case. She has always been well except for occasional spells of headache and vomiting at irregular and infrequent intervals. Thyroidectomy was done when she was 19 years of age, for simple enlarged thyroid; tonsillectomy at age of 22. Aside from occasional attacks of precordial pain suggesting pyrosis, her cardiorespiratory history is negative. Her appetitie has been fair up to time of an attack of influenza in 1918. She has had constipation for the past 3 years. She had a miscarriage with her first pregnancy, but has had two children since who are living and well.

In November, 1918, patient had influenza, from which she dates the onset of her present trouble. Following this she had more frequent headaches, irregular spells of vomiting, constipation, irregular and varying abdominal pains which were not localized. Her appetite was poor and she had pyrosis and gaseous eructations and occasional attacks of vertigo. In October, 1919, an appendectomy and gastro-enterostomy was done. Following this, her symptoms became exaggerated. In addition to her previous symptoms she had attacks of burning urination with diminished output, and in January, 1920, she had an attack of numbness and spasticity in the arms and legs. She has lost 45 pounds in weight. Her vomiting spells have occurred daily of late and have no relation to the taking of food. Weakness has been gradually becoming worse.

*Physical examination.* Patient is small anæmic woman appearing chronically ill. There is marked evidence of loss of weight and dehydration. Eyes react normally. There is considerable pyorrhœa and the tongue is dry. There is a scar on the neck from thyroidectomy. The heart is not enlarged and the sounds are normal. The lungs are clear on percussion and auscultation. Blood pressure: systolic, 112; diastolic, 72 millimeters mercury. There is an adherent scar in the upper right rectus region. The abdomen is scaphoid, there is no rigidity, but there is moderate tenderness on palpation. Peristaltic waves can be noted in the epigastrium at times. At the region of the lower border of the stomach tympany, there is mass about 2 by 5 centimeters which is somewhat movable transversely and is slightly tender. Pelvic organs are normal. Reflexes are normal.

Urine shows a trace of albumin at times, otherwise normal. Wassermann is negative. Basal metabolism is normal. Blood shows hæmoglobin, 68%; red blood cells, 4,720,000; white blood cells, 9,400; differential normal. Stomach contents: total acid varied from 12 to 35 per cent; free hydrochloric acid absent; bile at time. Fæces: guaiac, negative.

Roentgenological examination by Dr. Allison shows a marked prolapse of the stomach with a gastro-enterostomy opening on the greater curvature and gastric contents passing out of stomach freely both through the pylorus and by gastro-enterostomy. There is no evidence of gastric or duodenal ulcer.

Neurological examination by Dr. Nixon.

*Conclusion.* From the history, patient has apparently had two definite attacks of tetany. The gastric disturbances are not typically those of tetany but with these attacks it is at least very suggestive that the condition may become gastric tetany if allowed to progress.

After 6 weeks of study and treatment on the medical service during which time the vomiting and abdominal distress continued and patient's general condition gradually became worse, regardless of treatment, she was transferred to the surgical service for operation, for relief of the vicious circle.

*Operation,* May 8, 1920, by Dr. Law. Old upper right rectus scar dissected out. Dense fibrous adhesions found between omentum, stomach, liver, and anterior abdominal wall. Duodenum and stomach were carefully explored and no ulcer or scars found. Stomach was greatly prolapsed and a gastro-enterostomy opening found which was three times the normal size. Distal to the opening the jejunum

was found kinked and held so by fibrous tissue. Adhesions were freed and the stoma exposed. Rubber-covered clamps were placed on the stomach and bowel and the stomach was incised 1 centimeter distal to the line of union with the jejunum. The openings were closed by an inner layer of catgut sutures, Connell method, and an outer Cushing stitch of linen.

Convalescence was very stormy for the first few days, due chiefly to the extremely poor condition which she was in before the operation. Her wound healed normally and she was able to take the usual diet given to the gastric cases. She recovered slowly but was able to leave the hospital 4 weeks after her operation and was entirely free from her former gastric symptoms.

April 16, 1921, patient returned to hospital by request and was looking well and happy. Her weight before operation was 84 pounds and she now weighs 135½ pounds. She has no vomiting spells and can eat anything. Her appetite is good and her bowels are regular. She is still gaining weight.

Case 2. Miss T. B., age 25, white, was referred to the University Hospital from the University Dispensary March 3, 1921, on account of epigastric pain, frequent spells of vomiting bile-stained material, and loss of weight. Her family history has no bearing on the case. Patient's health was good until the age of 14. She had the usual childhood diseases with no sequelæ. She had typhoid fever at 21. When 16 she had ear trouble and at 19 she had a mastoid operation on the right side and 8 months later the left mastoid was operated upon. Four years later it was found necessary to do the right mastoid operation again. She had ulcers in her nose which were operated upon at the age of 24 and she had her tonsils removed at the age of 20. Aside from occasional cough and some cardiac palpitation at times, her cardiorespiratory history is negative. Her appendix was removed when she was 19 and when 21 a right inguinal hernia was repaired. At the time of the last operation a tumor on the right hip was removed. At the age of 22 a right nephropexy was performed and 1 year later a cyst of the right ovary was removed. She had had "stomach trouble" for several years which was characterized by epigastric pain and frequent attacks of vomiting. The pain had no time relation to meals and was not relieved by soda or by taking of food. Following the oophorectomy she had frequent attacks of vomiting and was unable to take any food. Diagnosis of gastric ulcer was made by her physician and he then performed a gastro-enterostomy, 5 weeks after the oophorectomy, which gave her relief for 4 months. She had had some dysuria and difficulty in starting to void at times. She has occasional spells of frequency and has nocturia three or four times each night. Her menstrual history has been normal. Her operations numbered thirteen in all.

For 3 or 4 months after her last operation, the gastro-enterostomy, she was relieved of the vomiting and pain and then her symptoms recurred and for the past 2 years her symptoms have been nearly constant. She has lost nearly 25 pounds in weight. At first the attacks came on every few days and gradually increased in frequency until the present time when she has three or four vomiting spells every day. Shortly after taking food she has pain which is followed by the vomiting of bile-stained gastric contents. Vomiting simply increases the pain and the attacks continue until she is exhausted. It is not relieved by staying in bed.

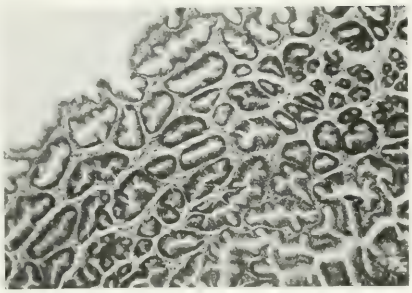

Fig. 3. Experiment 1. Photomicrograph of the transplanted stomach wall, which shows the general conformation of the glandular portion of the wall and the normal appearance of the glands.

*Physical examination.* Patient is a well developed, well nourished, rather nervous and excitable young woman. Her eyes react to light and accommodation. There are scars behind both ears and the nasal septum is perforated. Her teeth are in poor condition and her tonsils have been removed. The heart is not enlarged and the sounds are normal. There are a few scattered râles in lungs which are otherwise normal. Aside from the abdominal scars the abdomen is normal. There are no masses or acute tenderness. Reflexes are present and active. Pelvic organs normal.

The urine is normal; the fæces, with a guaiac test negative; Wassermann, negative. Hæmoglobin 70 per cent; white blood cells, 11,000. Test meal: total acid, 22 per cent; free hydrochloric acid, 12 per cent; guaiac, positive.

Roentgenological examination of the stomach by Dr. Allison shows a well functioning gastro-enterostomy and no evidence of gastric ulcer.

In view of the absence of any evidence of disease in the stomach, the presence of a gastro-enterostomy and the symptoms of a vicious circle, an operation disconnecting the gastro-enterostomy was indicated.

*Operation,* March 16, 1921, by Dr. Stiachauer. An incision was made excising the former upper right rectus scar. There was a moderate number of adhesions about the site of the gastro-enterostomy, the opening was of the usual size and in good working order. Rubber covered clamps were placed

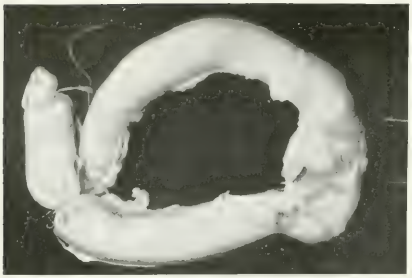

Fig. 4. Dog. Experiment 2. Photograph of distended jejunum, hardened in formalin. Instruments point to the ends of the closed stoma. Note absence of constriction.

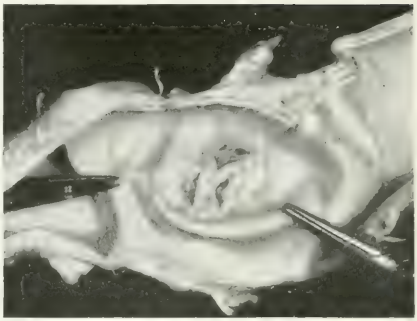

Fig. 5. Experiment 2. Photograph of hardened specimen cut open longitudinally along mesenteric border. Note the gastric mucosa surrounded by jejunal mucosa.

on the intestine at each end of the anastomotic opening leaving sufficient room to work, and two additional clamps were placed on the stomach about a half inch from the line of union with the jejunum. A cuff of stomach 1 centimeter wide was cut off and closed with three layers of catgut sutures. The stomach was closed in a similar manner and the opening in the transverse mesocolon closed. This was preceded by a careful examination of the stomach which revealed no gastric lesion.

Convalescence was uneventful. There was no increase in the pulse rate or the temperature beyond the usual slight reaction. She took the usual diet given to stomach cases and at the end of 2 weeks was taking a light diet and in 3 weeks was taking a general diet with five meals per day. She vomited twice while coming out of ether and vomited once on the nineteenth day following a dose of liquid albolene.

On the twenty-seventh day fluoroscopic examination by Dr. C. B. Wright showed the barium going through in good shape immediately after the meal and there was a marked constriction at the pyloric end of the stomach. (Probably due to the closure of the gastric stoma.) There was no residue in the stomach at the end of six hours.

Discharged one month after the operation feeling well, no vomiting and taking five small meals per day of regular diet.

Case 3. Mr. F. L., age 22, white, a patient under the care of Dr. H. P. Ritchie, of St. Paul, complained of epigastric pain, loss of weight, and vomiting after taking food during the past 3½ years.

His family history has no bearing on the case and his past history is unimportant.

Three and one-half years ago patient began having pain in the epigastrium, burning in character and beginning 2 hours after eating. The attacks were relieved at this time by rest in bed. Three years ago he was operated upon by another surgeon and a gastro-enterostomy and appendectomy were done. The result was only temporary. He is now vomiting and the stomach washings show retained food.

Fluoroscopic examination shows the stomach at the iliac crest. No peristaltic waves can be noted. When the stomach is compressed, barium passes through the pylorus without apparent obstruction. The stomach was much distorted suggesting hourglass contraction, which was later noted on the plates. No evidence of gastro-enterostomy can be noted by passage of barium from the stomach. Conclusions: Normal pylorus and duodenum with no evidence of obstruction. Gastric constriction due probably to non-functioning gastro-enterostomy high up on posterior wall of stomach.

*Operation*, April 2, 1921, at the Miller Hospital, by Dr. H. P. Ritchie. Old scar excised, adhesions freed, and stomach explored carefully. There was a possible scar at the pylorus suggesting a healed ulcer but it was not palpable. The gastro-enterostomy was antiperistaltic and well done except that it was high on the posterior wall. The stomach was greatly dilated and ptotic. Since the radiographic examination showed no function of this opening it was disconnected by turning in a cuff of stomach wall over the opening in the jejunum. Recovery was uneventful and there was every evidence subjectively and objectively of immediate and complete relief of his symptoms.

With this type of disconnecting operation the question obviously arises as to the ultimate fate of the transplanted stomach wall. Although it is reasonable to suppose that this tissue can be transplanted, it seems that under the conditions of altered blood and nerve supply, and in an alkaline medium, certain changes may take place, and it would be worth while to prove experimentally the pres-

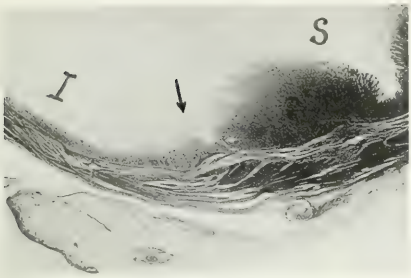


Fig. 6. Experiment 2. Photomicrograph, low power, of line of union of the jejunal wall and the transplanted stomach. The arrow points to the junction of the gastric and jejunal mucosa. The preservation of the various layers of the walls of each can be readily seen. Note the absence of scar tissue. *s*, stomach; *i*, intestine.

ence or absence of changes in the transplanted tissue as well as the ultimate condition of the lumen of the jejunum. If it were simply to become scar tissue it would at least act as a splint to cover in the defect and would prevent any further diminution in the jejunal circumference.

To determine this point the following experiments were undertaken. Gastro-enterostomies were performed and after the minimal length of time in which one might wait for results in a patient the disconnecting operation was performed. Owing to the difficulty in keeping the dogs the experiments were terminated at the end of 11 months. Autopsies were performed about 6 months after the disconnecting operation.

*Experiment No. 1, May 15, 1920.* Female spitz and collie dog. Posterior gastro-enterostomy 2 inches long, through transverse mesocolon, isoperistaltic, using three rows of sutures posteriorly and two rows anteriorly. Linen was used for the first and last rows and tanned gut for the remaining three rows. Closure in tiers and the dog recovered without complications.

October 25, 1920, 5 months later, the disconnecting operation was performed. The mesentery of the transverse colon in a dog is so short that the disconnecting operation was quite trying due to the difficulty in sufficiently mobilizing the transverse colon. Having mobilized the site of anastomosis, the opening was found to be satisfactory and working. Two rubber-covered clamps were placed on the jejunum at either end of the anastomosis and a third clamp was placed on the stomach about 1.5 centimeters away from the line of anastomosis,

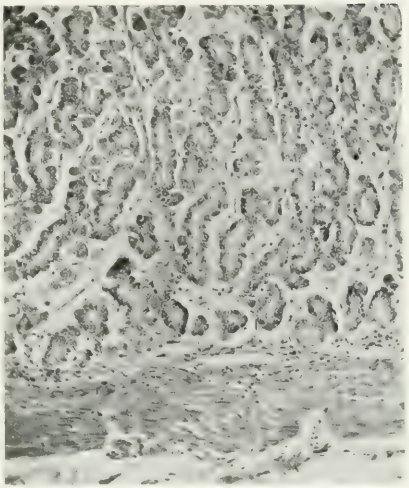

Fig. 7. Experiment 2. Photomicrograph, high power, showing the glands in the transplanted gastric mucosa. The chief and parietal cells can be readily seen and there is no apparent increase in the intertubular connective tissue. The cells appear normal.

and the stomach was cut away leaving a cuff of stomach tissue which was about 1 centimeter wide at the widest point and was slightly narrower at the ends of the jejunal opening. The stomach was closed with three rows of catgut sutures and the opening in the transverse colon was sutured. On examination of the jejunal opening there were no ulcers and the line of union of the stomach tissue and the intestinal wall was plainly visible and well healed. Closure was made with one row of Connell sutures and a second row of Lembert sutures. When completed the diameter of the intestine at this point was about normal. The animal recovered without complications.

April 8, 1921, *Autopsy*, 5½ months later. There was a moderate number of adhesions about the site of operation. No evidence of obstruction or constriction of the lumen of the jejunum (Fig. 1). On opening the gut longitudinally opposite to the line of suture the transplanted gastric mucosa was of normal appearance and had not decreased much in size (Fig. 2). Sections made which include the intestinal and gastric walls (Fig. 3), show normal appearing gastric mucosa and no increase in the connective tissue.

*Experiment No. 2, June 3, 1920.* Female terrier dog. Posterior gastro-enterostomy, 2 inches long, anterior to the transverse colon isoperistaltic, three rows of sutures posteriorly and two rows anteriorly, using linen for the first and last rows and tanned gut for the other three. Closure of the abdominal wall was done in tiers. Patient made uncomplicated recovery.

October 18, 1920, 4½ months later, a disconnecting operation was performed. Gastro-enterostomy opening was found to be open and in good working order. There was a moderate amount of omental adhesions about the site of the anastomosis which was easily mobilized. Curved rubber-covered clamps were placed on the jejunum at either end of the anastomotic opening and two rubber-covered clamps were placed on the stomach from each side about a half inch away from the line of the opening. The stomach was then cut away leaving a cuff of stomach tissue which was 1 centimeter wide at the widest point and was slightly narrower at either end of the jejunal opening. The narrowing of the cuff at either end prevents the formation of blind pouches at each end of the line of closure in the jejunum. The stomach was closed with three layers of tanned gut sutures. The opening in the intestine was closed with two rows of Lembert sutures. When the closure was completed the gut was of normal size and there was no evidence of constriction at the site of the former opening. The stomach flaps were anæmic but bled slightly and appeared viable. Uncomplicated recovery.

*Autopsy*, April 1, 1921, 5½ months later. There was a moderate number of omental adhesions about the jejunum at the site of operation. There was no evidence of obstruction or constriction of the lumen of the jejunum (Fig. 4). On opening the jejunum longitudinally the transplanted gastric mucosa was of normal appearance and was but slightly decreased in size (Fig. 5). Sections made which include the intestinal and transplanted gastric walls (Figs. 6 and 7) show that the transplanted stomach tissue has retained its normal appearance and the various layers can be readily made out. The high-power figure shows the normal appearing glands without increase of the intertubular connective tissue. The chief and parietal cells of the gastric glands retain their staining properties.

The two experimental cases cited show that the method of using a cuff of stomach wall is sound in principle and accomplishes all that is intended without harm to the structures involved. It is of interest to note the preservation of the stomach tissue although transferred from an acid to an alkaline medium and deprived of its original blood and nerve supply.

## CONCLUSIONS

Gastro-enterostomy should not be performed without demonstration at the time of operation of the definite indication or lesion.

Disconnecting gastrojejunal stomata should be preceded by most careful clinical and laboratory studies.

From the three clinical cases cited it is seen that the closure of gastro-intestinal anastomoses may be often indicated, and that it is a safe procedure.

The results in the three clinical cases and the two animal experiments prove the value of the use of a cuff of stomach wall and the efficiency of the method to prevent constriction.

The Andrews operation with the slight modifications suggested should become a standardized procedure as long as the indiscriminate use of gastro-enterostomy, without indication, is continued.

# MYCETOMA

## Report of a Case[1]

By H. L. D. KIRKHAM, M.D., F.A.C.S., Houston, Texas

MYCETOMA, though known and described by ancient Indian writers, has been considered quite rare and looked upon as essentially a disease of India. It is possible that it is not as rare as has been supposed, especially in tropical and semi-tropical countries. Probably many cases of mycetoma have been incorrectly diagnosed elephantiasis, and vice-versa. But since we have learned more of its pathology, this should not occur.

It was first described as a distinct disease in Bret's *Surgery*, in 1840; but many early writers considered the disease as tuberculous. Its parasitic nature was first suggested by Ballingall in 1855, but it was not until 1874 that V. Carter found the causal organism. Cultural methods at this time were crude, and though cases were reported by Bassini in Italy in 1888, by Vincent in Algeria in 1894, and the first case in Canada by Adami and Kirkpatrick in 1895, many of these were regarded as identical with actinomycosis, and it was not until 1906 that Brumpt published a paper showing that actinomycosis was a separate and distinct disease from the other varieties of mycetoma which are caused by separate varieties of fungi.

This disease is distributed throughout the world; but, due to its prevalence in India, it has always been regarded more or less as a disease peculiar to that country. From the number of cases reported from the different parts of the world, and especially from the Southern States and Central America, it is very probable that its incidence is of far greater frequency than is generally supposed; and it is also probable that many cases are incorrectly diagnosed as actinomycosis.

### ETIOLOGY

Most commonly we have a history of some injury sometimes insignificant which allows the fungus to enter the subcutaneous tissues. The disease is most commonly seen in the foot, hence its name, Madura foot; occasionally it is seen in the hand and rarely in other regions.

There are two main types of the disease dependent on the color of the granules which can be expressed from the lesions; namely, white and black. However, there are many strains of mycetes which have been classed as causative. The following classification with the date and name of its discoverer, is perhaps the most complete.

| GENUS | | SPECIES |
|---|---|---|
| Ascomycetes | Aspergillus | A. Nidularis (Eidam) 1883. |
| | | A. Bouffard's (Brumpt) 1906. |
| | Ospora | O. Tozeuri (Nicolle & Pinoy) 1907. |
| Hyphomycetes | Discomycetes | D. Bovis (Harz) 1897. |
| | | D. Maduræ (Vincent) 1894. |
| | | D. Asteroides (Eppinger) 1899. |
| | Madurella | M. Mycetomi (Laveran) 1902. |
| | Indiella | I. Mansoni (Brumpt) 1906. |
| | | I. Reynieri (Brumpt) 1906. |
| | | I. Somaliensis (Brumpt) 1906. |

With the exception that the discomyces bovis lives in spiklets of various cereals, little is known of the saphrophytic life of these fungi. It is most common in the barefoot races in the poorer class, and in males.

### PATHOLOGY

Essentially this disease is a hyaline degeneration and necrosis which attacks all tissues, even at times the bones, with a formation of fibrous tissue with giant and epithelioid cells and little attempt on the part of the body at reaction Due to the very complete pathological report of the reported case, nothing will be added here.

### SYMPTOMATOLOGY

The disease usually begins in the foot following an injury often insignificant; but

[1] Read before the Texas Surgical Society.

Fig. 1. Colony of actinomyces maduræ under the epidermis.

sometimes the hand, leg, neck, or trunk may be affected

Soon after the original wound is healed, there is swelling and pain in the affected part with a blackish discoloration of the skin, and the formation of hard lumps which have a tendency to bleed and show the formation of sinuses which discharge an oily fluid containing the characteristic granules In different parts of the foot, new nodules appear and the foot swells until it is ultimately converted into a more or less shapeless mass. The patient frequently complains of a sensation of foreign body in the foot. In most cases the dorsum of the foot seems more affected than the plantar aspect. Practically no effect is noticed upon the system in general. The condition often lasts for years, or until the part becomes so swollen that the patient is incapacitated from walking.

DIAGNOSIS

The diagnosis is based on the peculiar swelling of the foot with the formation of sinuses which discharge the characteristic sclerotia The diagnosis is confirmed by isolating the fungus and can be grown on ordinary media and is a facultative aerobe. On glycerinated agar it forms discoid colonies white in the center, reddish at the periphery.

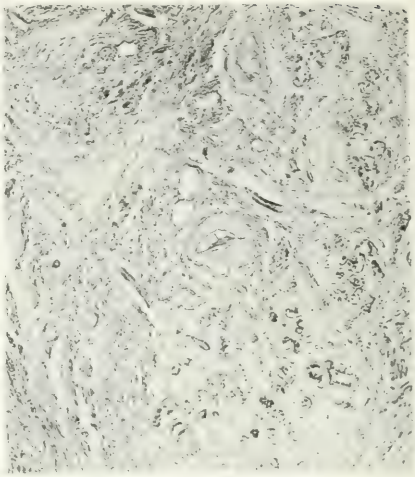

Fig. 2. Fibrosis and round cell infiltration surrounding a sweat gland.

The mycelian threads and spherical bodies are gram positive, but not acid fast. It must be differentiated from tubercular disease of the foot, actinomycosis, and elephantiasis.

PROGNOSIS

The disease is incurable unless treated surgically.

TREATMENT

In well marked cases amputation affords the only hope of relief. Unlike actinomycosis, iodide of potash in even large doses, has no effect.

CLINICAL HISTORY

Working diagnosis: mycetoma; final diagnosis: mycetoma. Patient, age 22; male; nationality, Mexican; occupation, laborer; present address, Houston, Texas. The family history is unimportant. Patient has had the usual diseases of childhood, otherwise had always been healthy. He denies all venereal history. Does not use alcohol; smokes cigarettes. The present trouble began 11 years ago when the patient, while barefooted, jumped a ditch and received a slight injury to the third toe of the left foot. The patient states that there was no abrasion or break of any kind of the skin. There had been no injury to this foot previously, to the knowledge of the patient. Following this injury there was slight pain, and in about 3 weeks he noticed a

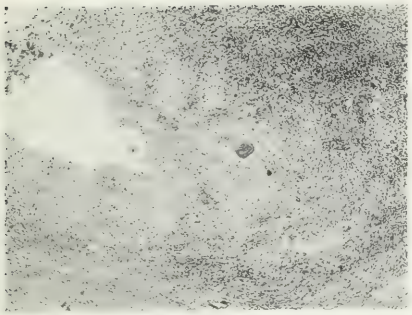

Fig. 3. Area of round cell infiltration showing two giant cells, one of which is in the center of the field. A fungus colony has been torn out of the space at the left.

blackening of the skin on the dorsum of the injured toe, and there soon appeared a "boil" which gave up a small amount of white, pus-like material. The blackened area persisted, and in the one year's time had extended to the adjacent toes, and throughout a semicircular area radiating from the base of the injured toe. Also there had appeared three or four nodules, which soon began to suppurate and give up a white or yellowish white and bloody fluid. Three or 4 years from the date of the original injury the patient first noticed small yellowish bodies in the exudate. These bodies were rather hard and about the size of a pin head. The area of involvement gradually extended, new nodules appearing as the zone of discoloration approached the ankle. At no time did he feel any great pain, but a slight pricking sensation was noticeable at times, especially at night. The patient states that his foot feels as if something were in it. He has been working up until the past few weeks, when the size of his foot interfered with walking.

General condition, temperature 98.2°; height 5 feet, 8 inches; weight 120 pounds; pulse 76, full and regular; respiration 16; patient fairly well nourished. There is slight anæmia of the conjunctivæ, the tonsils are somewhat enlarged, the teeth in good condition.

The lungs and heart are normal. The abdomen is slightly scaphoid, otherwise negative. The genito-urinary system is normal. The urine is of light amber color; with acid reaction; specific gravity 1020; albumin negative; sugar negative; acetone negative; indican negative. Microscopically there are a few epithelial cells; urates; few leucocytes; débris; no casts.

Blood count: reds 4,200,000; hæmoglobin 85 per cent; whites 7,800. Differential: polymorphonuclears 71 per cent; small mononuclear leucocytes 7 per cent. Transitional 1 per cent. Eosinophiles 1 per cent.

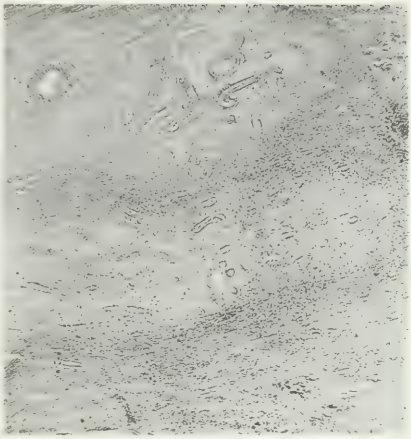

Fig. 4. Area of young granulation tissue replacing an inflamed area.

Examination of the skin, bones, and joints, is negative except that the left foot is greatly swollen and misshapen. On the dorsum the skin is blackened, and near the ankle it gradually fades into the normal color. Distally are warty growths and nodules, some as large as a fifty cent piece, covered with a thin, yellow crust. Just proximal to this area are several slightly raised areas, one of which on incision gave up a fluid mostly blood. One of the suppurating nodules on incision gave up small yellowish granules. The plantar surface of the foot is clear of discoloration, and shows nodular growths only in the region of the third toe, and one inch posterior to the tarsophalangeal articulation of the great toe. The apices of these nodules are marked by sinus openings.

The foot was amputated under ether anæsthesia in the lower third of the leg by a long posterior flap and short anterior flap.

Recovery was normal, the wound healed by first intention; convalescence showed no untoward symptoms. After 6 months the patient appears perfectly normal.

PATHOLOGICAL REPORT

*A. Gross pathology.* Left foot specimen with leg trimmed off 2 inches below malleoli. Foot in good state of preservation except that the epidermis of the sole is macerated and nearly all peeled off. A couple of deep incisions 3 or 4 inches long have been made in the sole, and another 1½ inches long near the inner malleolus evidently to facilitate penetration by formalin.

The anterior half of the foot has a markedly swollen appearance which extends to and includes the

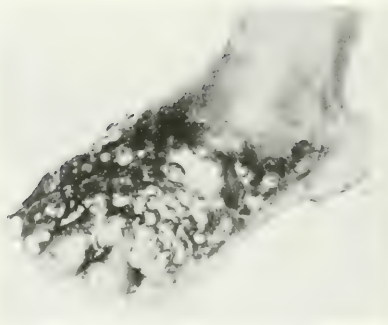

Fig. 1. Patient's foot before removal.

toes. The heel and ankle appear normal. The toes are not separated. While some of the swelling is observed on the plantar aspect, the most is apparent dorsally. The foot is not discolored.

*Dorsum.* On the dorsal aspect of the foot, extending posteriorly for about 2 inches from the insertion of the toes, are numerous tubercular nodules of a round or oval outline, with coarse granulations about 4 millimeters in heighth, and varying from 2 to 25 millimeters in diameter. Their borders are either perpendicularly elevated or slightly overhanging with a granular summit, or else the whole nodule is convex. They are most numerous at the base of the second toe nearly to the nail. On the inner side of the dorsum, some extend over 2 inches anterior to the base of the great toe; on the outer side a few extend posteriorly to the vertical plane of the external malleolus. Where most abundant they are in close contact and the largest mass, between the bases of the second and third toes, is apparently made up of a coalescence of several. The apex of many is ulcerated, and in some of the ulcers mark the opening of definite sinuses extending into the foot. The color of these nodules is lighter than the healthy skin.

*Plantar.* A nodule similar to the foregoing may be observed on either side of the third toe. None are observed on the sole, except a small cluster about 1 inch posterior to the tarsophalangeal articulation of the great toe. These masses protrude through the epidermis of the sole, which seems to be punched out of their base, and does not extend over their summit. These are yellowish in color, and the apices of several are marked by sinus openings. The foot was divided into eight sections by vertical and oblique sections. It was necessary to use the saw to cut the bones in every section made.

*B. Internal Pathology.* The subcutaneous fat on the plantar aspect appears normal in amount throughout the length of the foot, but has disappeared from the dorsal aspect. The tendons of the plantar aspect are readily discernible, but are less readily made out on the dorsal. The muscles have almost entirely disappeared. The place of the dorsal subcutaneous fat is occupied by a dense mass of connective tissue, extending clear to the bones. The bony tissues along the line of the sections are apparently unchanged.

On the dorsum of the foot, embedded in the strands of connective tissue, are numerous sinuses, some single, some lying in groups, each group surrounded by strands of connective tissue. Their diameter varies from 1 to 2 millimeters; but, in places they may be expanded 4 millimeters. A few are filled with a translucent, coagulated, albuminous material, others appear empty, while others appear with a yellowish, necrotic débris. In others are observed yellowish, mulberry shaped granules, apparently filling the entire lumen of the sinus. These sinuses extend up into the nodules on the surface of the skin, but extend in every direction within the substance of the foot. The sinuses appear to be lined by a yellowish, necrotic membrane, which appears thicker where the tunnels are massed together. A few poorly developed sinuses are observed near the bony arch. The tuberculations on the skin, when cut across in sections, appear to be inverted cones with their apices embedded from 5 to 10 millimeters deep in the connective tissue.

On the dorsum, near the ankle, the connective tissue appears normal, and fat is still embedded below the heel, the muscles are still intact, though considerably degenerated. The granules previously noted are for the most part not over 1 millimeter in diameter and are of a yellow color. They are relatively scanty. Some mulberry-like aggregations of these granules not over 2 millimeters in diameter are noted. They are not present in cavernous-like expansion of the sinuses.

*C. Pathological histology.* Blocks of tissue were removed for examination, including apparently unaffected skin overlying a group of sinuses, and similar blocks including nodules where sinuses were actively discharging material.

In studying the nodules one can distinctly make out two stages, (1) where the nodule is in process of formation but is not sinus crowned, and (2) where the nodule is sinus crowned. In the first situation the malpighian layer of the epidermis over the developing nodule, appears very much thinned out, and the papillæ are markedly atrophied. The nodule itself consists of a hyperplasia of young connective tissue with areas in which there is considerable infiltration with fibroblasts.

In the second instance the malpighian layer at the apex is very much thinned, while at the sinus opening it is entirely eroded and around the edges of the opening, is necrotic. At the periphery of the nodule there is considerable hyperplasia of the papillary, with the malpighian layer penetrating downward in thin finger-like prolongation. There is some round cell infiltration of the papillary layer. The center of the nodule is filled with a closely

packed accumulation of polymorphonuclear cells interspersed with a few lymphocytes. At the periphery loops of capillaries extend into the mass.

The subcutaneous tissue is increased in quantity and is undergoing very extensive hyaline degeneration. The sinuses either single or in groups are surrounded by particularly dense masses of connective tissue, and here and there are seen considerable aggregations of round cells.

The sinuses appear to lie in more or less parallel groups of two or three poorly distinguished or separate channels, cut across in various planes. Individual channels may be separated by a thin connective-tissue septa. Sinus channels vary considerably in apparent age. In apparently old channels no granules are visible, very few polymorphonuclear cells are seen and the lumen is filled with capillary loops, and an infiltration of fibroblasts. Where granules are present in the channel, the cellular exudate immediately about the granules is a dense infiltration of polymorphonuclear leucocytes; but along the walls of the sinus, round cells blend with the polymorphonuclears, and repair is evident by the formation of capillary loops.

Round or oval giant cells with smooth margins and containing 20 to 50 or more evenly distributed or peripherally situated nuclei are sparingly present in the cellular infiltration of the sinus channel. They are not seen in close proximity to the granules. Their cytoplasm is quite dense. No pigment is seen in the tissue.

Plasma cells are seen in the sinuses undergoing repair. No round cell infiltration of blood vessel walls is noted.

Scattered irregularly throughout the tissues lying either within the sinus channels in the fibrous walls of the sinuses, or in the hypertrophied connective tissue at a distance and with or without small red-cell accumulation about them, are numerous aggregations of spherical gram-positive bodies varying in size from 1 to 8 microns in diameter. For the most part any great like mass is composed of bodies of the same size usually from 4 to 5 microns. Usually the groups of this size have associated with them smaller bodies about 1 micron in diameter.

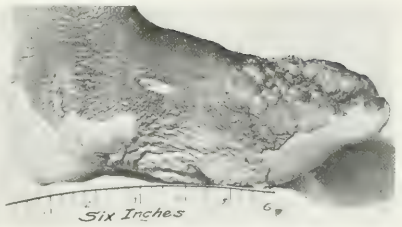


Fig. 6. Amputated foot.

The granules lying within the sinuses are apparently homogeneous staining (with eosin) slightly more intensely at the periphery than at the center. Hæmatoxylin, or gentian violet, does not stain any element within. In the peripheral zone of more intense staining there is a suggestion of radial striation. Smears of granules likewise fail to reveal any evidence of mycelian filaments.

I wish to express my indebtedness to Dr. Mark F. Boyd for his pathological report on this case, and to Dr. Violet Keiller and Dr. G. C. Lechenger for their photographic work.

# DEPARTMENT OF TECHNIQUE

## TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR

By HERBERT P. H. GALLOWAY, M.D., C.M., F.A.C.S., Winnipeg, Manitoba

IT is universally conceded that fracture of the neck of the femur is a serious surgical condition. A large majority of the cases occur at an age when prolonged confinement to bed and sudden interruption of habitual activities are badly borne. Not a few of the patients are alcoholics and quite frequently, especially in this class, the injury occurs under such circumstances that the patient undergoes prolonged exposure to inclement weather. It is small wonder, therefore, that a considerable mortality attends this injury. In the cases which are not fatal, non-union or mal-union is almost invariable. This is due to the poor blood supply to the proximal fragment, and also to the fact that a large proportion of these fractures are impacted, and the surgeon, following traditional teaching, fears to disturb the impaction lest the last state of his patient should be worse than the first.

In view of these generally admitted facts it would seem desirable that each surgeon should set down clearly some general rules which will reduce the management of these difficult cases to something approaching a safe and rational routine. The purpose of this paper is to present the conclusions the writer has arrived at for his personal guidance as a result of his own experience.

As seen in practice, fractures of the neck of the femur fall more or less naturally into several groups. In the first group are patients of advanced age and general feebleness whose resisting power is at a low ebb. The heart is weak; circulation is poor. Sudden confinement to bed is irksome. The liability to hypostatic congestion constitutes an ever present danger. Under such circumstances we instinctively recognize the necessity of treating the patient rather than the fracture. Treatment resolves itself largely into good nursing, and efforts to make the patient as comfortable as possible. We support the fractured limb in an easy position by carefully adjusted pillows and sandbags. We endeavor to ward off lung complications by elevation of the head of the bedstead, and by frequently changing the patient's position. We do not hesitate to prop the patient up in the sitting position, and even to get him out of bed, as soon as this can be done without too much discomfort. Detailed care in regard to cheerful surroundings, to food, laxatives, stimulants, and the relief of pain should all be included in the management of the case. We do not expect a good functional result; should the patient survive, the future use of crutches is accepted as practically inevitable.

The second group is made up of patients sufficiently vigorous to rally quickly from the first shock of the accident and who do not appear to be threatened by the complications which menace the patients of the first group. This second group also includes most cases of impacted fracture, as well as those of epiphyseal separation and fracture of the neck of the femur occurring in early life; the same general line of treatment is applicable to all of them. Here the surgeon's responsibility is of a different order; it is his duty to make a conscientious and determined effort to secure for his patient such a functional result as shall prevent future disability or discomfort. Without attempting to review and compare the relative merits of the various methods by which the desired end may be sought, it is my personal opinion that the abduction treatment introduced by Whitman will give a larger percentage of good results than any other. It is not sufficient, however, merely to place the affected limb in the abducted position and retain it there in plaster of Paris for a given number of weeks; such a perfunctory performance only discredits the method and brings sure disappointment to both patient and surgeon. Unless the surgeon has a clear understanding how to proceed and is prepared to carry out the treatment systematically and with careful attention to every detail, he had better employ some more conventional method, otherwise he is almost certain to fail of reaching the desired goal for the simple reason that he has been following a false trail. In an emergency a suitable sacral support screwed to the end of a table, with a suitcase, or box of similar size and

shape to support the patient's shoulders, and a perineal post or a roller towel passed between the thighs for counterpressure, can be made to answer every purpose; but a special orthopedic table of the Hawley pattern is so much superior and more convenient that it should always be employed in hospital practice.

The patient is first clothed in either a combination suit or long stockinette drawers extending from the nipples to the toes. His back is protected by a heavy felt pad about 10 inches wide and 18 inches long, stitched to the stockinette so as to extend from the lower part of the sacrum to the mid-thoracic region. The patient, anæsthetized, is arranged upon the table with the lower part of the back resting on the sacral support, and the counterpressure post, padded with a towel, pressing against the pubes and perineum. Sufficiently strong manual traction is then applied to both limbs by assistants to equalize the length of the limbs, the surgeon at the same time lifting and pressing upon the trochanter so as to guide it to its normal position. As soon as measurements show the limbs to be of equal length while the pelvis is level, any remaining outward rotation is corrected by grasping the foot and rotating the limb until the patella points slightly inward, but the traction must not be relaxed while this maneuver is being carried out. Still maintaining the traction the limbs are simultaneously abducted to the extreme limit. If a final examination shows the pelvis level, the limbs of equal length, and the angle of abduction the same on both sides, the limbs and trunk are quickly bandaged with rolls of sheet wadding and a plaster spica applied extending from the nipples to the toes. Additional security of fixation is afforded by the plan of extending the plaster a short distance down the sound thigh; but if full abduction of both limbs is maintained while the plaster is being applied, and if the plaster is carried sufficiently high on the trunk, it is quite safe to leave the other thigh free, and, after hardening has taken place, to trim the plaster in such a way that there is no obstacle to flexion of the sound hip.

Care should be taken to place the foot at right angles to the leg, and the knee will be more comfortable if allowed to flex a few degrees while the plaster is hardening. The efficiency of the dressing will not be diminished if a window of considerable size is cut out over the abdomen, and this will add materially to the patient's comfort by permitting freer breathing. Another window should be cut out over front of knee to allow daily passive movement of the patella.

If the plaster has been properly applied the patient will not find it at all intolerable, and his position in bed can be changed as freely and as frequently as he desires without any danger of disturbing the fracture.

The dressing should remain undisturbed for 3 months; after being removed massage, passive movements, and functional muscle training will materially assist recovery and should be carried out daily for a number of weeks. Direct weight-bearing should never be permitted in adult patients inside of 6 months, and usually should be prohibited for a longer time. The process of repair can be judged to some extent by repeated X-ray pictures, but too great reliance must not be placed on radiographic appearances, experience having shown that union which in the picture looks to be perfectly sound may yield under the influence of the body weight. Freedom from discomfort during passive manipulation, and restoration of voluntary muscular control, afford much more reliable information as to the firmness of the repair. In most cases it will be safer to provide the patient with a caliper splint so adjusted that the bulk of the weight will be transmitted directly to the pelvis instead of coming upon the recently fractured neck of the femur; this splint should be applied before weight-bearing is permitted and be worn for several months.

I have purposely avoided using the term "intracapsular" and "extracapsular," for they have little or no practical bearing on the subject under discussion.

The term "impacted" cannot, however, be dismissed quite so summarily. There are cases where nothing but a slight crumpling or telescoping of the neck of the femur has occurred. The shortening is insignificant; there is a very slight degree of outward rotation and only moderate discomfort or functional disability. Massage should be used from the first and a short period of confinement to bed, followed by the use of crutches, a caliper splint, or even only a stout stick, will complete the treatment. A good functional recovery with only slight lameness and some limitation of movement will be the ultimate outcome.

The severer degrees of impaction should be treated by the abduction method just as if the impaction did not exist; indeed, it is by no means always as easy to determine whether the fracture is impacted or free, as the textbook descriptions would lead one to suppose.

The functional recovery in bad cases of impaction is rarely satisfactory. The limb is short and

and may remain more or less painful indefinitely. There is sure to be some permanent restriction of movement. It is much better to disimpact, and this is accomplished by the same series of manipulations as are employed when the fracture is known not to be impacted, the limb being then put up in the abducted position as already described. The average ultimate result is certain to be more satisfactory than if the surgeon allows himself to be misled into inactivity by fear that disimpaction may result in non-union. As a matter of fact disimpaction in these cases rarely, if ever, means that contact of the fragments with one another is interrupted. The changed relation is comparable to that which occurs when a green-stick fracture is carefully straightened; consequently, while the deformity is corrected the probability of bony union occurring is not unfavorably influenced if the contact of the fragments is maintained by efficient abduction treatment. The ease with which disimpaction can be accomplished by the same series of manipulations that we use in cases which are not impacted, affords convincing evidence that impaction does not always mean that firm locking together of fragments which constitutes the traditional conception of this condition.

As Whitman first pointed out, fracture of the neck of the femur and epiphyseal separation are by no means uncommon in childhood and adolescence. In these cases the abduction treatment, properly carried out, will nearly always yield excellent functional results and in less time than is required for older patients.

There remains to be considered the group of cases which we encounter weeks, months, or even years after the original injury, the patient complaining of varying degrees of discomfort and disability. At one extreme is the patient who suffers nothing more than slight lameness and moderate discomfort after over-exertion, but who is unable to understand why he should not be entirely well and comfortable if he had been properly treated at the beginning. Most of these patients can be dismissed without treatment and will go away satisfied after it has been carefully explained that a perfect recovery after such a serious injury as fracture of the neck of the femur is very exceptional, that they must be thankful for being disabled to only a small extent, and must philosophically adjust their activities to the fact that the injured limb can never again be one hundred per cent efficient. At the other extreme is the patient who is unable to walk without crutches and who suffers more or less constant discomfort, and sometimes actual pain, and is in consequence forced to abandon most of customary activities.

While the patients in this group present problems which may be more or less individual in certain details, roughly speaking they will be found to separate into two subgroups: those who should be submitted to operation and those who should not. If the patient be very advanced in years, in poor general health or greatly enfeebled from any cause, we must be content with efforts to make him more comfortable by the use of radiant heat, massage, gentle passive movements and exercises. He must also be provided with a comfortable shoe with sufficient cork elevation to compensate for shortening; this will prevent the additional discomfort which results from tilting the pelvis at a time of life when the lumbar spine has lost much of its earlier flexibility. Further, the wise surgeon will not neglect the patient's mental attitude, and can often do much good by cultivating in him a spirit of cheerful acceptance of his physical limitations. But if careful examination shows the patient to be free from organic disease and in possession of a fair degree of resisting power, relief should be attempted by operation. What shall this operation be?

It will not be disputed that a relatively simple operation from which the patient will recover in a few weeks, which can be quickly performed with little shock and with a minimum loss of blood, which will not prevent the patient from being moved freely in bed in the after-treatment, and which is reasonably certain to afford a fairly good ultimate functional result, has distinct advantages over more complicated procedures which entail greater traumatism, more immediate danger, and a longer period of convalescence. Such an operation is found in complete removal of the head and neck of the femur, followed by implantation of the trochanter in the acetabulum.

I am not a stranger to other methods of operation. I have tried opening up the region anteriorly and directly adjusting the fragments after freshening the fractured surfaces. This is not a difficult operation, but it has few advantages over the abduction treatment without operation and requires quite as prolonged a period of convalescence and after-care as the latter.

I have had no personal experience with Brackett's method of attempting to bring about union between the head and the trochanter, but I have on several occasions successfully pinned the fragments together with a bone-graft. My opinion is that such operations are much more difficult and attended by greater risk; they require

a much longer period of convalescence and will not give better average functional results than the simpler operation herewith advocated.

The operation is performed as follows: Gas-oxygen anæsthesia preferred; patient supported partly on the sound side by large sandbags. Kocher incision about 8 inches long extending about 4 inches upward and backward from the top of the trochanter in the direction of the fibers of the gluteus maximus and downward along the outer side of the femur for about the same distance. This incision should be clean and rapid. The first cut will usually expose the gluteus maximus above and the fascia lata below. By incising the fascia lata in the line of the lower arm of the incision the attachment of the gluteus medius is fully exposed. In that part of the incision above the trochanter the fibers of the gluteus maximus can be separated with very little use of the knife, or, better still, the upper border of the muscle is defined and retracted backward. An incision carried to the bone is then made along the line of insertion of the gluteus medius, extending from the anterior border of the trochanter upward and backward to the upper angle of the trochanter posteriorly. The whole upper end of the trochanter is then quickly cleared, either by dissecting close to the bone with a sharp knife, leaving only the periosteum, or by detaching the periosteum itself with a chisel and mallet, leaving the bone bare. I have come to prefer the former method because it is better to have the trochanter, which comes into contact with the cartilage of the acetabulum, covered with soft tissue, as a precaution against ankylosis. Keeping close to the bone and working from behind forward and upward the gluteus medius is detached. From the anterior face of the trochanter the gluteus minimus is severed; working backward along the summit of the bone the pyriformis, and behind it the obturator internus with the two gemelli are set free, and dipping down on the inner aspect the obturator externus is liberated from the digital fossa. The description seems lengthy, but the maneuver can be executed in one continuous rapid movement.

Having cleared the trochanter and exposed the capsule, this structure is split along the axis of the neck and separated from its attachment by a circular incision, the assistant meanwhile rotating the limb inward or outward, as directed, so as to provide access to all aspects of the outer part of the neck. If not already separated the base of the neck is divided from the trochanter with a wide osteotome, and the thigh being flexed, adducted, and rotated inward by an assistant, the inner aspect of the femur can be quickly smoothed as low as the upper border of the lesser trochanter. In most cases this should be done before any attempt is made to remove the head from the acetabulum as more room is thus obtained. In old cases with fibrous union the forced flexion, adduction, and inward rotation may dislocate the head more or less completely, but when the head is completely detached and remains like a ball in the socket it can be removed by using a wide Jones gouge as a lever; should there be any difficulty the head may be split with a chisel into two or more fragments which are then removed by lever and lion-jaw forceps. By abduction of the limb and direct pressure the trochanter is then easily guided deeply into the acetabulum, and this abducted position must be steadily maintained until the plaster dressing has been applied. With a large curved needle and a continuous stout catgut suture the separated muscles are drawn together and stitched to the outer aspect of the trochanter. The fascia is also repaired with catgut and the skin brought together with silkworm gut. Over abundant padding, special attention being given to the comfortable protection of the sacrum and spine, a plaster spica is then applied from the nipples to the toes, the thigh being kept fully abducted and, as in the cases which are not submitted to operation, the dressing will be more comfortable if the knee is kept slightly flexed. The foot should, of course, be placed at a right angle to the leg. This dressing need not be disturbed for 5 or 6 weeks, and in the meantime no harm will result from moving the patient about in bed with any desired frequency. It is impossible to disturb the wound or change the position of the femur to any harmful extent if the patient be turned partly or wholly on the side, or even on the face. While wearing the plaster the patient can be taught to exercise the quadriceps, and in fact nearly all groups of muscles in the leg and thigh, by trying to make the movements which bring the various groups into play. These efforts will do much to preserve muscular tone and diminish the tendency to atrophy. This kind of muscular exercise should be encouraged, not merely in cases which are operated upon, but in all patients in whom the abduction treatment in plaster of Paris is carried out. Having removed the plaster at the end of 5 or 6 weeks, massage and gentle manipulation should be commenced; while movement will at first be more or less painful, usually it is not more than a fortnight before the patient can be got out of bed.

Standing on the feet, supported on either side, then the use of crutches, and finally the sub-

stitution of a stick for the crutches, follow in natural sequence. Ultimately it may be possible to dispense with even a walking stick. A fair degree of movement is regained, and in the end there is little discomfort and only a trifling amount of shortening.

It must not be supposed that the trochanter always remains deeply implanted in the acetabulum; indeed an X-ray picture taken a few months after the operation may in some cases alarm the uninitiated by giving the impression of impending dislocation, or at least mechanical insecurity. A moment's consideration of the anatomical conformation of the parts will show that as abduction is reduced the top of the trochanter tends to travel outward on the roof of the acetabulum, and with the extremity brought to the vertical position the X-ray may show the top of the trochanter resting somewhere about the upper part of the rim of the acetabulum; but development of sufficient strong fibrous tissue has taken place in the meantime to provide secure anchorage and there is no upward riding when weight is borne on the limb.

While the description of the operation is apt to convey the impression that it is difficult and complicated, it is possible, after one has acquired familiarity with it, to carry it out with considerable speed, a factor of great importance in patients who are aged or not very vigorous. The skin should be prepared and the draping of the patient with sterile sheets and towels completed before the anæsthetic is administered. It is quite possible to have the trochanter in the acetabulum and closure of the wound begun in 8 or 10 minutes from the time of making the first incision, and with good assistance the plaster should be in place and the patient ready to be returned to bed in not more than three-quarters of an hour from the time the operation was commenced; in one of my recent patients, a lady 74 years, this was accomplished in 34 minutes (Case 6). The loss of blood is usually trifling. I have performed the operation without tying a single vessel, but usually two or three ligatures are necessary. Even in patients of advanced age there is often no evidence of shock.

My confidence in this operation, as applied to fracture of the neck of the femur, grew out of a fairly large experience with the good functional result following removal of the head and neck and implantation of the trochanter in the acetabulum in cases of osteo-arthritis and tuberculosis of the hip, in bad cases of coxa vara, and in selected cases of congenital dislocation where the patient had reached an age when reduction without removal of the head was impossible. In fact, the functional result in most cases following the operation, for whatsoever reason performed, is usually so good that in my opinion its application to fracture of the neck of the femur might be extended much more widely than I am advocating in this paper. If, by an operation which is attended by little risk, the patient can be given a limb that functionally is as good as, or better than, that which can be secured by the best conservative treatment, and if this result can be achieved in half the time, there does not seem any reason why the operative method should not become more or less a matter of routine in the hands of skilled surgeons. At any rate my personal confidence has reached the point where I am prepared to extend the scope of this operation very considerably, as I am persuaded it might well be applied to a large proportion of the cases usually treated by the Whitman abduction method. Brief reports of six cases treated by this operation will now be given.

Case 1. Mrs. J., age 55. Four months before she came for advice, patient had fallen and "sprained" her right hip. She did not have any medical treatment. Patient was unable to walk without crutches; X-ray showed the head of the femur to be detached. Operation May 20, 1919, when the head was removed and the trochanter placed in the acetabulum as described. Patient made uneventful recovery; plaster was removed in 6 weeks and patient encouraged to move limb. Movements were at first uncomfortable, but the discomfort soon largely subsided and within a few weeks patient was able to walk with reasonable freedom. The final note of this patient's history sheet bears date February 17, 1920, and reads: "Examined today. Result is entirely satisfactory; she limps a little and has about three-quarters of an inch of shortening but there is good movement in abduction and adduction, and about 60° of flexion. She suffers very little discomfort."

Case 2. J. M., male. Gave his age as 63 but looked like a man 10 years older. His arteries were hard and calcified. He also had an enlarged prostate and a double inguinal hernia. Three weeks before I saw him he had severely injured his right hip. The patient was suffering so much pain that a satisfactory examination was impossible. He could not lie down with any comfort nor allow the limb to be straightened. It was necessary to administer an anæsthetic before an X-ray picture could be taken. The picture showed fracture of the neck of the femur. Operation in this instance was not an inviting proposition but something had to be done to relieve his suffering, and I decided that operation would probably be less dangerous than any other course. It would have been impossible to apply adhesive straps for extension without an anæsthetic, and I felt satisfied the patient would not tolerate the extension after it had been applied; and the abduction treatment without operation meant a too prolonged period of invalidism. Operation October 4, 1919. The head and neck were excised and trochanter placed in the acetabulum; limb was widely abducted in plaster. Practically from the first hour patient was comfortable. He was very thin, and unfortunately, while still in the plaster, developed a bad bedsore in the dorsal region which took

a long time to heal. The plaster was removed in 6 weeks. Patient was feeble, bladder and bowels gave trouble; the double rupture did not add to his comfort and he suffered additional disadvantage from his bedsore; but notwithstanding all these drawbacks, he was soon sitting up part of the time and was removed from the hospital to his home 2 months after the operation. Functional recovery was very slow. Two months later, while free from pain, he was unable to move about without leaning on a chair. Patient's general feebleness was largely responsible for his slow recovery. This was an extreme case but illustrates that the operation itself need not place the patient in danger. I last saw this patient on May 11, 1920, 7 months and 1 week from the time of his operation. He could walk without any aid whatever, but used a crutch and stick as he was unsteady and feared that he might fall. He was comfortable and could flex the thigh sufficiently to permit him to sit upright in an ordinary chair. He was constantly gaining, and it was quite evident that further functional improvement would occur as time passed.

Case 3. Mrs. K., age 68, suffered a fracture of neck of right femur 7 months before I saw her. She suffered a great deal of pain and was unable to bear much weight on the limb. She did not use crutches and moved about very little and only by pushing a chair before her. She also had fibrous ankylosis of the right knee, permitting only 20° of flexion. X-ray showed fracture with non-union, the trochanter being high above the head. Operation October 23, 1919; the head and neck were removed and the trochanter implanted in the acetabulum. After the first few days the patient was very comfortable. Plaster cast was removed in 6 weeks. Radiant heat and massage treatment was commenced at once, and patient encouraged to get out of bed daily. In 4 weeks she was able to get about the room freely and comfortably with the aid of a chair. Recovery in this case was hampered by the accompanying partial ankylosis of the knee. She was last examined on May 7, 1920. She was very comfortable and constantly improving; she walked well with the aid of a walking stick which she used chiefly because it gave her a sense of greater security.

Case 4. Mrs. M., age 40, was first seen on February 28, 1918. Patient said she had injured the upper part of her left thigh 5 weeks before she consulted me. She did not think her hip had been injured. She had never been able to walk since her accident but could move about the room assisted by a crutch and another person supporting her. Examination showed the limb an inch and a half short, the foot rotated outward and the trochanter much above the normal level. X-ray showed fracture of neck of femur. Operation on March 4, 1918. The fracture was exposed through an anterior incision and the head found completely separated from the neck and loose in the acetabulum. The fragments were freshened and manipulated as far as possible into normal relationship. Through an external incision an awl was inserted through the great trochanter and neck up to the head so as to gain exact information regarding the direction to be followed by the large electrically driven drill by which a suitable tunnel was created through the trochanter and neck; a bone-graft was then driven through this tunnel so as to pin head and neck together. A plaster spica was worn until June 11, 1918. Six weeks later the patient was walking well with only a stick. On December 9, it was noted that her condition was very satisfactory, there being but little lameness and only a trifling amount of shortening. Patient did not report again for 6 months. She called at my office on March 2, 1919, for examination, stating that she thought the limb was becoming shorter and had been less comfortable for a number of weeks. Examination revealed shortening of an inch and a quarter, and X-ray showed that the neck of the bone had given way and had been partially absorbed. As patient's general health was unsatisfactory at this time she was referred to Dr. Burridge who, in the course of a systematic investigation of the case discovered that she had a 3+ Wassermann, and he placed her under appropriate anti-syphilitic treatment for a number of months. I examined her again on December 4, 1919. There was a great deal of lameness and considerable pain; she used a stick all the time. A stereoscopic X-ray picture showed the head behind the trochanter where it was evidently serving no useful purpose. On December 30, I excised the head and the remainder of the neck and placed the trochanter in the acetabulum. The limb was dressed in plaster in wide abduction in the usual manner. Plaster was removed on February 7, and patient left the hospital a few days later. On February 24 (a little less than two months after her operation), she came to my office on crutches. The limb was comfortable and she would walk across the room without even a stick. She continued to improve steadily and in another month was walking well, but when going any distance she still used a stick. X-ray picture showed the head resting near the rim of the acetabulum, but there was perfect mechanical security.

Case 5. Mrs. J., age 74. Severe fracture of neck of femur 2 weeks before I first saw her. Patient was well preserved for her age. Operation was advised and was carried out on April 30, 1920. Patient was fully prepared before the anæsthetic was started. Gas-oxygen anæsthesia was administered by Dr. Webster. Head and neck removed in the usual way and trochanter smoothed off and placed in acetabulum. In 34 minutes from the time the incision was commenced the plaster dressing was in place and the patient ready to be returned to the ward. At no time did she have the slightest evidence of shock, and recovery proceeded uneventfully. Patient left the hospital for her home 12 days after the operation.

Case 6. Mrs. McD., age 50, first consulted me on May 19, 1920. Eight years before I saw her she developed left hemiplegia which left her with a useless arm, but she was able to get about actively until August, 1919, when a large dog ran against her and knocked her over, since which time she had never been able to walk at all. The limb was short and everted and movements considerably restricted. There was also marked contracture of the tendo achillis making it impossible to bring the foot to a right angle with the leg. X-ray picture showed fracture of the neck of the femur. Practically all of the neck had been absorbed and the trochanter was on a considerably higher level than the head. Operation on May 26, through Kocher incision, the remaining fragment of the neck was removed leaving the inner aspect of the trochanter smooth. The head was then taken away and the trochanter implanted in the acetabulum with the limb moderately abducted. The wound was closed and the plaster spica completed in 40 minutes from the commencement of the operation. Patient was a large fleshy woman so that the wound was very deep and the operation more difficult than usual. Gas-oxygen anæsthetic was used. There was absolutely no evidence of shock. The patient withstood the operation well and has done uninterruptedly well since but the operation was performed too recently to make possible any opinion as to the ultimate functional result.

# POSTEROLATERAL INCISION FOR THE REMOVAL OF LOOSE BODIES FROM THE POSTERIOR COMPARTMENT OF THE KNEE-JOINT

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LOOSE bodies are not infrequently present in the posterior compartment of the knee-joint. Occasionally they may wander into the anterior compartment and be readily accessible, but more often they are too large for this and it is necessary to remove them through an incision that will permit access to the posterior compartment of the joint. Brackett and Osgood[1] in 1911 described an incision through the popliteal space which is excellent but entails careful dissection in order to avoid the popliteal vessels and nerves, and it is difficult to make particularly in fleshy or muscular patients.

The posterior compartment of the knee-joint is practically divided by a mesial septum into internal posterior and external posterior compartments. A posterolateral incision is therefore often necessary on both sides, in order that the exploration for the bodies may be completed, but both incisions are small and practically no dissection is needed.

The knee is prepared in the usual manner and a tourniquet applied. The foot of the table is not dropped as in explorations for semilunar cartilages, or in splitting the patella. The knee is flexed to a right angle, thus relaxing its posterior capsule. If the loose bodies are all in the outer division of the posterior compartment the incision should be made posteriorly, well on the outer side but in front of the fibula (Fig. 1). A semilunar incision with the convexity anteriorly or posteriorly may be made in the skin, and a straight incision parallel with the longitudinal axis of the leg made in the capsule. This may be enlarged and retractors placed to give an excellent view of the posterior cavity of the joint. A large curette or gall-stone scoop may be used to explore and remove the loose bodies. The mesial septum

[1] Brackett, E. G., and Osgood, R. B. The popliteal incision for the removal of "joint mice" in the posterior capsule of the knee-joint. A report of cases. Boston M. & S. J., 1911, clxv, 978-979.

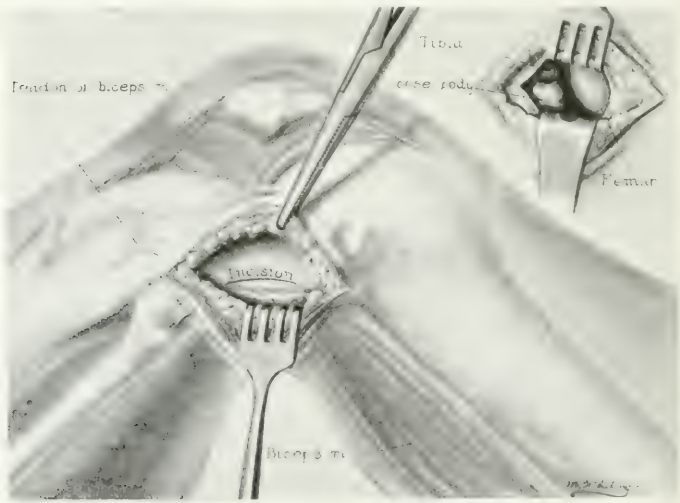


Fig. 1. External posterolateral incision. Insert shows loose body.

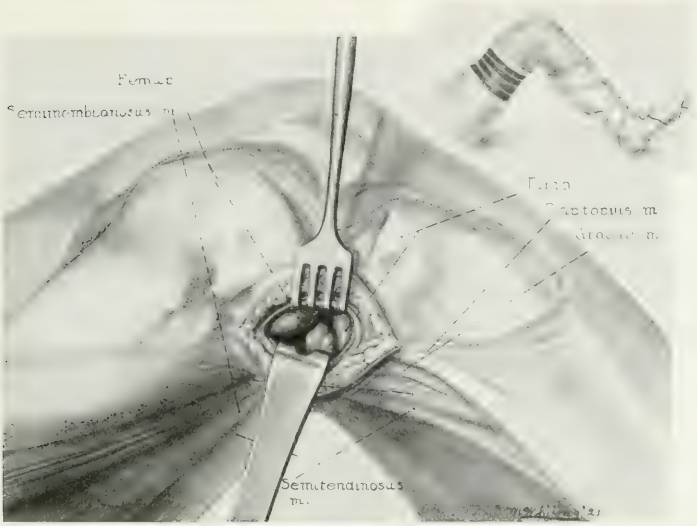


Fig. 2. Internal posterior lateral incision. Insert shows knee flexed to the right angle, and the position of the leg on the operating table.

prevents ready access to the inner compartment, and if exploration on that side is necessary, rather than to cause trauma to the interior of the joint by forcing an instrument through it, an incision similar to the one just described should be made on the inner side. This is anterior to the relaxed tendons of the semitendinosus, semimembranosus, cartorius, and gracilis muscles (Fig. 2), and gives ready access to the inner division of the posterior compartment. Plain catgut sutures are used to close the capsule and silkworm and dermal sutures to close the skin. Fixation in plaster of Paris or by splint is not necessary although it may be employed for 24 to 48 hours to prevent bleeding that may follow involuntary movements of patient on coming out of anæsthetic.

# TREATMENT OF CARIES OF THE HIP-JOINT AND SOME OBSERVATIONS UPON THE USE OF A TRACTION ABDUCTION SPLINT

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THE treatment of hip disease is a highly desirable surgical achievement as the affection is not uncommon and is a formidable one. It appears, however, that the best method of treating this affection has not been generally employed, if it be possible to judge from the cases brought to the Massachusetts Hospital School from the different parts of the state. A reason for this is to be found in the fact that few cases are treated from start to finish by the same doctor. As a result, the methods of treatment used are of the nature of temporary experiments rather than parts of a consistent plan. The records of the Massachusetts State institution which are full and comprise histories of approximately two hundred cases during several years of close observation, show that patients suffering from undoubted hip disease, consistently treated, may be absolutely and permanently cured in a large number of cases and that the consequences of faulty methods are lamentable. In untreated hip disease, nature never cures without deformity, while in properly managed cases deformity does not occur. Not only is the mortality much lower in well treated cases than under partial treatment, but also the functional result after proper treatment is incomparably superior. In the cases which form a basis of this statement, there can be no reasonable doubt of the correctness of the diagnosis, as no case was recorded as one of hip disease which was not examined by a number of experienced observers with the aid, in many cases, of roentgenogram and reaction tests, as well as a careful examination of previous histories. The term "hip disease" is used as defining a chronic carious process attacking the bones of the hip-joint. No attempt is made to classify according to the localization of the original focus or to the character of the invading germ, that is, bovine or human tuberculosis, or as to mixed or pus-making bacilli. One case is presented as illustrative.

Figs. 1, 2, and 3. Case 1. Photographs taken 2 years after discharge from hospital.

CASE 1. (Figures 1, 2, and 3.) Patient previously treated with plaster spica. He had pain, spasm, slight

Fig. 4. Plaster-of-Paris spica.

Fig. 5. Plaster-of-Paris spica

Fig. 6. Short plaster spica bandage.
Fig. 7. Long plaster spica bandage.

motion, and 40° flexion on admission. Duration of disease 1 year. After admission he was treated with traction abduction splint, high sole, and crutches for 3 years. Pictures were taken 2 years after discharged. Patient has full motion and no shortening.

Judging from the clinical histories of many of the cases brought to the Hospital School, mistakes were made in failing to recognize the disease at an early stage. The invasion is usually insidious and both the parents and the doctor hesitate to condemn a child on slight evidence to the rigors of strict treatment. An X-ray print shows no bone destruction at the earliest stage, little progress having as yet been made by the disease.

A temporizing policy is too often adopted, to the great detriment of the joint. A definite diagnosis is not difficult, even at an early stage, certain symptoms being almost pathognomonic. A persistent limp, however slight, combined with limited passive and active motion in all directions at the hip-joint means threatened carious destruction of the joint and the need of carefully protecting it from any injurious pressure or trauma.

Nature cures a carious hip by flexing and adducting the thigh through muscular contraction of the periarticular hip muscles. This guards the joint from injurious jar. If the carious process is extensive and both the femoral head and the acetabulum are involved, the natural cure is accomplished by the exaggerated pressure of the femoral head crowded against the upper and posterior part of the socket through the excessive contraction of the joint muscles. This increased pressure increases the bone destruction of the

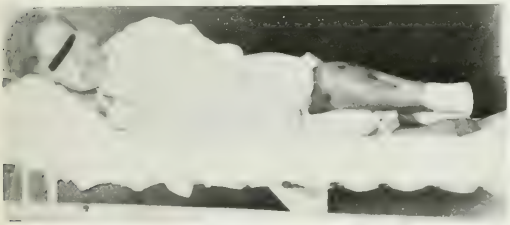

Fig. 8. Case 2.

Fig. 9. Case 2.

Fig. 10. Case 3.

Fig. 11. Roentgenogram taken 22 years after subtrochanteric osteotomy.

femoral head and eventually a subluxation takes place. Pressure being in this way relieved between the carious bone structures, the diseased bone tends to heal unless later septic complications incident to the discharge of carious detritus abscess formation, sinus and mixed infection, destroy the patient's life.

The purpose of the surgical art is to aid nature's cure and this is accomplished by checking joint bone crowding. Constantly bruised bone tissue is slow in healing and the surgeon should seek to favor recovery by protecting the epiphyseal ends from this form of injury.

Judging from a considerable number of cases subjected to plaster-of-Paris spica bandage treatment, the surgical indications are not fully met by this form of restraint (Figures 4 and 5). The chief defect of the plaster spica method is that it fails to furnish either adequate fixation or to counteract upward hip bone crowding by the contracting hip muscles. It may serve as a temporary aid in transporting a patient with a sensitive hip; but it is readily seen that it is next to impossible to apply a plaster bandage which if long continued does not become burdensome to the patient. Soft tissue and bone atrophy, as well as an unhealthy condition of the skin, necessarily follow. The patient's general condition suffers as he finds himself uncomfortably walled about in a stiff plaster case.

As success in the treatment of bone tuberculosis depends to a considerable extent upon the patient's condition, the continued use of a long plaster spica bandage cannot be recommended, while to be content with a short spica is to be satisfied in hip caries with inadequacy (Figures 6 and 7).

Satisfactory results have been obtained at the Massachusetts Hospital School by the employment of an abducting extension splint which had previously been proved to be of service at the Children's Hospital in Boston. Other forms of traction splint used elsewhere have not proved as satisfactory as the one here mentioned. The simpler form is more readily manufactured, more easily applied, and without perineal straps furnishes better fixation, as well as abducting traction.

The splint should not be applied until extreme flexion or adduction deformity is corrected, and although it is intended to be used as an ambulatory apparatus and can be so employed even in acute cases, the additional precaution of crutches is advisable except in the convalescent stage when the splint can serve as a perineal crutch, discontinuing the traction straps. Traction having been removed, the appliance has an important advantage in furnishing proper opposition to adductor contraction. The continued use of the splint is indicated as long as muscular spasm is present. Traction can be gradually diminished as spasm subsides. The apparatus can be worn at night or traction with bed frame fixation can be substituted.

The effectiveness of the abducting traction splint in fixing the hip and in counteracting injurious muscular force is illustrated in its usefulness in the treatment of fractures of the femoral neck.[1] Success in the treatment of hip disease necessarily depends upon the condition of the tissues when thorough treatment is begun. Much benefit can be hoped for even in advanced cases, as is seen from the following case histories.

Case 2. Figures 8 and 9. A 13 year old Jewish boy suffered from tuberculous disease of the hip-joint previously treated before admission with plaster spicas. After

[1] New York M. J. [illegible], Nov. [illegible]

admission he was treated with traction abduction splint, high sole, and crutches. About a year later sinuses appeared with marked destruction of tissue followed by development of amyloid disease. Seven years after admission there was a gradual improvement with cessation of sinuses and receding of liver's edge. Two years later traction was discontinued and splint removed the following year. At present patient is working every day.

Case 3. (Fig. 10.) A bright, 13 year old girl had double hip disease of a year's duration. Examination on admission showed motion in flexion 45°, abduction 30°, and adduction 30° in both hips: no rotation; muscular spasm present; both legs equal length; moderate amount of trochanteric thickening; many healed sinuses; hyperextension limited; treated with traction abduction splints, high sole, and crutches for nearly 2 years, followed by convalescent splint for 1 year. Discharged 8 months later recovered, to attend high school.

When the carious process is healed with marked deformity and bony ankylosis, splint treatment is evidently of no benefit. This condition is not common in young children and none is reported in the series here considered. The best method of meeting this condition is by subtrochanteric osteotomy, correcting the flexion and placing the limb in an abducted position in order to give the tilted pelvis a practical increase of the length. The accompanying X-ray (Fig. 11) is of interest as showing a result taken 22 years after a subtrochanteric osteotomy for the correction of an ankylosed right angle flexion with adduction following hip disease. The patient has been engaged since operation in an active occupation for 20 years, walking with no apparent shortening and with scarcely perceptible limp.

In desperate cases in which the acetabulum is seriously involved, a method can be employed which, judging from the experience of the few cases in which it has been applied, deserves more general consideration than it has yet received. A free posterior incision is made down to the joint, the head is forcibly pulled out of the socket, and the limb held in a flexed and adducted position by a plaster anterior splint, freeing the diseased acetabulum from bone pressure by forcibly dislocating the hip and draining the acetabulum thoroughly by free incision. Locomotion is soon possible with crutches, healing can be expected to take place as in the natural cure of hip disease, and the resulting deformity can later be corrected.

Anyone whose recollection goes back to the earliest methods of treatment and who compares the results then obtained with those observed at the Hospital School will be satisfied that progress has been made in an understanding of the nature of hip disease and of the principles which should govern treatment; but it also appears that plaster spica bandages do not give satisfaction as a method of treatment and should not be used except as an emergency and as a temporary measure.

A critical reader of the foregoing might hastily conclude that the most successful cases reported were not true cases of hip disease. He would, however, think differently if he had personally examined the patients and their clinical histories. Those most successfully treated were not selected and isolated examples but parts of a series including a comparatively large number of patients with similar characteristic syndromes carefully observed and recorded by well trained surgeons. The cases differed considerably in the amount of joint destruction which had taken place before entrance into the Hospital School and it was apparent that the more thorough the treatment in protecting the joint from injurious joint pressure, the better the ultimate functional result. If tuberculous foci of the lung and other tissue heal when favorable conditions are provided, the same can be expected to be true in bone. In the early stages of hip disease a germ-congested area in the epiphysis gives rise to joint symptoms before much change in the shape of the bone has occurred. If the morbid process is arrested in this stage, a complete functional recovery may be hoped for. The early acceptance of aseptic surgery was delayed, in many communities, by the skepticism of those who, having observed no benefit in the imperfect employment of improved methods, rejected their use. It is always easier to doubt than to form a judgment on thoughtfully studied facts. Ample evidence can be presented to those ready to examine facts demonstrating that caries of the hip-joint taken early and thoroughly treated is an affection which can be definitely cured with practical restoration of function.

# EDITORIAL


## SURGERY, GYNECOLOGY AND OBSTETRICS

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DECEMBER, 1921


## CONTRIBUTIONS OF SURGERY TO OUR KNOWLEDGE OF THE PHYSIOLOGY AND PATHOLOGY OF THE SPLEEN

A SENIOR medical student, up for his final examination, was asked by the professor of physiology, "What is the function of the spleen?" After considerable hesitation and digital irritation of the scalp he replied that he had known but had forgotten. "What a pity," said the professor, "for you are the only man who has ever known."

One of the most remarkable features of splenic pathology concerns the fact that the spleen is an organ which has great pathological potentialities, but which appears to have no function of sufficient importance to be disturbed by its removal.

A side light on the function of the spleen is its direct association with the liver, shown by the fact that whatever the function of the spleen may be, it is unable to complete the work that it initiates. The blood from the spleen must pass through nature's great metabolic laboratory, the liver, before it enters the general circulation.

Experimental work on the spleen on the whole has been disappointing. Some facts of value have been brought out, but there has been a fairly general failure to correlate experimental work on healthy animals with the disease conditions of the spleen in man, although after carefully reviewing this experimental evidence one is perhaps in a little better position to guess than he was before. After all, more dependence is as yet to be placed on mass clinical evidence than on animal experimentation. Out of the confusion certain facts and near facts can be discerned which at least demonstrate that the principal function of the adult spleen is directly connected with the blood, hence its huge supply of blood out of all proportion to other organs of its size, except the kidney. It is apparent, too, that the effect of the spleen on the blood is of a three-fold nature.

1. The spleen destroys deteriorated red corpuscles. Some of the enlargements of the spleen, as in hæmolytic icterus, might be regarded as work hypertrophy, and splenectomy gives brilliant results. In pernicious anæmia the patient is unable to produce normal red cells, and it may be that the spleen acts deleteriously by the destruction of red blood-corpuscles which, while reduced in value, are capable of function and are the best the patient can generate. This may explain the value of splenectomy in pernicious anæmia. Perhaps akin to this is the effect of the spleen on the blood of the patient suffering from so-called splenic anæmia in which the red blood-corpuscles are unnecessarily destroyed by an overaction of this particular function of the spleen which in splenic anæmia is in some way associated with increased size, thrombophlebitis, generalized fibrosis, and atrophy of the

pulp cells. In these splenomegalias splenectomy has great value.

2. One of the most interesting functions of the spleen is its strainer action by which microorganisms are removed from the blood-stream and sent to the liver for destruction. If the spleen is unable to deliver these microorganisms to the liver splenomegalias develop, such as occur in typhoid, chronic syphilis, malaria, and tuberculosis.

3. The third function of the spleen is largely hypothetic and stands on much less reliable ground, depending on experimental evidence about which no two experimenters are well agreed, but it seems reasonable to assume that the spleen may originate hormones which act through the blood-stream on organs at a distance, especially on the bone-marrow.

Polycythæmia may be the result of splenic hormones in the blood, the overstimulated bone marrow producing red cells in excess so that the number sometimes reaches as high as 9,000,000 to 12,000,000 and the hæmoglobin more than 100 per cent. The patient with polycythæmia (rubra vera) often appears cyanotic. In one case of this rare disease I removed the greatly enlarged spleen with extraordinary improvement. One cannot safely draw conclusions from a single case, especially in the light of postmortem findings following death from this disease. Pathological conditions in the living, however, have demonstrated over and over again that some conditions found at necropsy may be terminal, and nonexistent in the earlier stages of the disease. The result in this case suggests at least that the spleen plays a greater part in polycythæmia than has been believed and that in some cases splenectomy may be indicated.

Medical tradition is responsible for the statement that the patient with splenomyelogenous leukæmia will not live following removal of the spleen and for the further paradoxical statement that splenectomy can do no good if the patient does recover. The patient will volunteer the information that any method of treatment which will reduce the size of the spleen improves the general condition, and that whenever the effect of such remedial measures has passed off the spleen again enlarges and the general condition becomes worse. Certainly the idea that the spleen cannot be removed successfully in splenomyelogenous leukæmia is incorrect. In twenty-seven splenectomies in our experience for which the patients were properly prepared by irradiation of the spleen there was but one death, and that from embolus 2 weeks after operation. While the improvement was temporary in most instances a few of the patients have had such extraordinary betterment, lasting such a length of time as to suggest that they were not truly leukæmic; this illustrates how little we know about the spleen.

Accumulating clinical evidence goes to show that chronic enlargements of the spleen are to be looked on as potentially surgical, although not necessarily operative, and that we must in the future depend on massed clinical facts as well as on experimental evidence to develop our knowledge of the physiology and pathology of the spleen, and not be misled by what our forefathers thought and rashly committed to print.

William J. Mayo.

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

THE problem of keeping medical textbooks up to date is undeniably a difficult one, and increases in direct ratio to the size and comprehensiveness of the work involved. When a treatise on medical practice attains the size of Keen's *Surgery*,[1] the task of re-editing and keeping it abreast of the times becomes truly formidable. Dr. Keen and Messrs. Saunders have met the problem by the publication of two new volumes, VII and VIII, to supplement the original edition of five volumes, and of the sixth volume published 8 years ago.

Simply to read the names of the contributors to Keen's *Surgery* is to feel oneself in the midst of a notable company. The editor fittingly says in his preface, "I count it the crowning privilege of a long life to have been associated with so distinguished a company of authors."

With a work so extensive in its scope, it is impossible in a brief review to do justice to each individual part. Volume VII contains a number of chapters which are concerned chiefly with military organization and purely military surgery, and which need only to be mentioned. The most important feature of the volume is the section on bone and joint surgery, divided into "Fractures" by Eisendrath and Straus, "Gunshot Fractures" by Blake, "Military Surgery of Joints" by Pool, "Orthopedic Surgery in Civil Life" by Lovett, and "Military Orthopedic Surgery" by Jones and Hey-Groves. This group of articles constitutes an admirable symposium on a difficult problem, one which still confronts the surgeon, both in military and civil hospitals and in every-day practice.

The immediate treatment of compound fractures, the disposition of bone fragments, the use of antiseptic solutions, the repair of infected fractures, methods of splinting, the treatment of osteomyelitis, of persistent sinuses, of deformities, the operative treatment of fractures, are ably discussed by men who bring a full and thoughtful experience to the solution of these problems.

Gibbon contributes a well written chapter on Surgical Technique which admirably describes débridement and antiseptic treatment of wounds, as developed through war experiences. Thorburn, in a brief chapter on spine and cord injuries, and in a second chapter on the treatment of peripheral nerve injuries, summarizes the results of war experiences in these particular fields. Matas contributes a well illustrated chapter on surgery of the blood vessels, in which he illuminates with experienced judgment the work achieved in this particular field during the war.

Volume VIII comprises a wide range of subjects, possibly of more definite interest to the surgeon in civil practice. Diseases of the thyroid gland are discussed from different standpoints in three separate chapters: from the standpoint of surgical treatment by C. H. Mayo, of pathology by Wilson, and of chemistry by Kendall. The latter two chapters are brief résumés of the work of these writers in specialized fields.

Surgery of the head is divided into separate chapters, the first on the hypophysis by Adson; the second, a general discussion of cranial surgery, including the treatment of gunshot wounds of the head, by Neuhof; the third and fourth, on trigeminal neuralgia and tumors of the gasserian ganglion, by Frazier.

Two well illustrated chapters on wounds of the face and jaws by Harte and Lee, and Darcissac, emphasize not only the importance and difficulty of the new problems that the war forced upon the attention of surgeons, and the progress that was made in meeting them, but also the importance of co-operation between the general surgeon and the dental surgeon in securing the best results.

The chapter on surgery of the lungs and pleura by Heuer is the longest in the volume, perhaps fittingly so, since the advances made in thoracic surgery during the war were more radical than those in any other specialized field of surgery. Though the reader cannot help but feel that the final word is yet to be spoken on many phases of the problem, he cannot but be impressed by the achievements of war surgeons in the difficult field of chest surgery.

Two chapters among those remaining, one on surgery of the bladder and ureters by Bransford Lewis and the second on surgery of the prostate by Young, deserve special mention, because of their completeness, and their admirable descriptions and illustrations of modern diagnostic and operative methods.

A well illustrated chapter on physiotherapy by McKenzie, a chapter on radium therapy by Duane and Greenough, on the use of the X-ray by Cole and Steiner, on electrodessication and electrocoagulation by Clark, are ample evidence of the completeness with which these supplementary volumes have covered the field of modern surgery. With the previously published volumes they stand as a splendid monument to the industry and ability of the illustrious editor.

S. L. KOCH.

[1] Keen's Surgery: Its Principles and Practice. By various authors. Edited by William Wolfram Keen, M.D., LL.D. Vols. vii and viii and index. Philadelphia: W. B. Saunders Company. 1921.

# AMERICAN COLLEGE OF SURGEONS

## THE NINTH CONVOCATION OF THE AMERICAN COLLEGE OF SURGEONS; CONFERRING OF HONORARY FELLOWSHIPS IN THE ROYAL COLLEGE OF SURGEONS IN IRELAND

THE ninth Convocation of the American College of Surgeons was held in Philadelphia on October 28, 1921. Fellowships were conferred upon 721 candidates: 645 from the United States and possessions, 17 from Canada, 53 from South America, 3 from China, 1 from Korea, 1 from Syria, and 1 from the Bahrein Islands.

The Fellowship address was delivered by Sir Harold J. Stiles, K.B.E., Edinburgh, Scotland, and Honorary Fellowships were conferred upon Sir Harold J. Stiles, K.B.E., Edinburgh; Sir Robert Hy Woods, M.Ch. (Hon.), Past President, R.C.S.I., Dublin; Professor Hans Christian Jacobaeus, M.D., Stockholm; Professor Jean Frédéric de Quervain, M.D., Berne; Jan Schoemaker, M.D., The Hague; Miguel H. Alcivar, M.D., Guayaquil, Ecuador; Guillermo Gastañeta, M.D., Lima, Peru; João Alves de Lima, M.D., São Paulo, Brazil; José de Mendonça, M.D., Rio de Janeiro, Brazil; and Surgeon General Edward R. Stitt, United States Navy, Washington, D.C.

### CONFERRING OF HONORARY FELLOWSHIPS IN THE ROYAL COLLEGE OF SURGEONS IN IRELAND

THE ceremony of conferring Honorary Fellowships in the Royal College of Surgeons in Ireland upon eight distinguished American Surgeons was an occasion of deep interest to all Fellows of the College who were present at the ninth Convocation.

The delegation from the Irish College consisted of Sir Robert Hy Woods, M.Ch. (Hon.), Past President, R.C.S.I., and Sir William Taylor, K.B.E., C.B., also a Past President, R.C.S.I. These distinguished guests of the American College were introduced by Dr. Harvey Cushing of Boston, who said:

"On March 2nd of 1784 a College of Surgeons came into the world, as was quite fitting, in a Maternity Hospital. This was none other than the famous Dublin Rotunda founded long before by Surgeon Bartholomew Moss, but the event of which I speak took place not in a ward but in the Board Room and by Royal proclamation.

"To the country of Jonathan Swift, of Oliver Goldsmith, and of Edmund Burke the world owes a great debt. But in medicine no less than in literature and public affairs have Irishmen stood high in the English-speaking world. The medical history of ancient Erin reaches back to times prehistoric, when Druids were priests and physicians. She had in Thomas Molyneux in the 17th century a figure likened to the English Sydenham, and the following years have produced Irishmen whose names are permanently enrolled among the leaders of our profession.

"Irish doctors have not always stayed in Ireland for their life's work, but the names of some of those who did we may recall in association with their great contributions. John Cheyne and hydrocephalus, Abraham Colles and 'Colles' Law,' Robert Adams and heart-block, Corrigan and aortic insufficiency,—but above all there stand out two figures, Robert Graves and William Stokes, to whom students the world over flocked for inspiration at their rounds in the old Meath Hospital, where they so long served as friends and colleagues.

"Surgery, physic, and midwifery were not so differentiated in their day as in ours, and so it is that such a one as Abraham Colles, twice President of the College and its Professor of Anatomy and Surgery, is no less famed for the law he established before the spirochete was discovered than for the description of the fracture with which his name is coupled on the lips of every medical student the world over.

"Another of the band of Irish surgeons who made Dublin famous in Colles' day was Sir Philip Crompton, four times President of the College between the years 1811 and 1856 and one of the founders of that unique organization, the Zoological Society of Dublin. Members of the medical profession have indeed always been prominent in the highly cultivated and select social circle for which Dublin, like Edinburgh, has been so celebrated.

"In the winter of 1917-18, the Base Hospital to which I was attached had as its neighbor in

Wimereux a hospital set up on the site where, 100 years before, Napoleon had gathered his legions for an invasion of England. This was No. 83 Dublin General Hospital, the Chief Surgeon and organizer of which was Colonel Sir William Taylor, then President of the Irish College; and we learned to love and respect him and the members of his Unit, not only for their personal qualities but for the stand they had taken in regard to the war. At that time, in May of 1918, there had been something over 1,000 persons holding degrees of the Irish College who had been in uniform; 35 of them had been killed in action or had died in service; 36 had received the Military Cross; 45 the Distinguished Service Order; and 173 had been 'mentioned in despatches.' I may give a single instance of what it may mean for an Irish doctor to be mentioned in despatches.

"'Captain Henry James Burke, R.A.M.C., for conspicuous gallantry on 8th November, 1915, near Turco Farm. A sergeant in the front line had his leg crushed by the blowing in of a dug-out, and Captain Burke found immediate amputation necessary. In order to save time he crawled across the open to get his instruments, while the enemy turned a machine-gun on him. In spite of their fire he returned the same way, and coolly performed the operation in the trench while the enemy were shelling it heavily'.

"Irishmen do not do things according to precedent. Chary of its honorary degrees, the Irish College, though it has been known to give its honors *in absentia*, has never before, so far as I am aware, sent delegates to another country to confer them. But these delegates should feel at home in a land to which, since the establishment of the colonies, the Irish have come in such shoals that now the largest ward of Dublin is in South Boston, and the County Mayo in the minds of many is identified with Rochester, Minnesota.

"Favored indeed may our own American College regard itself by the acts of friendship displayed, first by the Royal College of Surgeons of England in sending its President, Sir Rickman John Godlee, to our inaugural and by the gift from members of their College (representing the Consulting Surgeons of the Armies of Britain) of the beautiful mace before us which will always figure in our future ceremonies. Now come representatives from the still older Irish College to bestow their honors on a few of our Fellows as a mark of their good will to us all.

"It is my privilege, gentlemen, to introduce to you Sir William Taylor and Sir Robert Hy Woods, of the Royal College of Surgeons in Ireland."

Sir William Taylor presented the United States surgeons for Honorary Fellowship in the Royal College of Surgeons in Ireland as follows:

"It is an unspeakable delight to me to be here amongst you again and I shall long cherish the honor which has fallen to me to come here on this occasion. I now beg to propose that the President of the American College of Surgeons do leave the Chair temporarily, and that Sir Robert Woods, Acting President of the Royal College of Surgeons in Ireland, do take the Chair."

"Mr. President: It is only right and proper that nations which have a common inheritance in language, institutions, customs and sympathies, and which are actuated by the same high ideals of love of liberty, and of justice, should do honor to each other, and I do not believe there is a place on the habitable surface of the globe so appropriate for such a function, as that in which we are now engaged, as this City of Philadelphia.

"If I remember my Greek aright, Philadelphia is derived from two Greek words, φιλος and ἄδελφος which translated freely mean 'Brotherly Love.'

"The responsibility of my duty is great, but yet greater is the happiness that it has fallen to my lot, in these days of political and sectarian disputes in our country, to be able to speak of the unanimous and genuine pleasure that the intention, on the part of our College, of conferring these Honorary Fellowships, created throughout the length and breadth of the land.

"We trust that the honors now about to be conferred by us as the representatives of the Royal College of Surgeons in Ireland may be taken, not only as an appreciation on the part of the College of the distinguished services rendered by each of the recipients to the great advance in the science and art of surgery, and of the very exalted position they individually occupy in the profession, but, as a further evidence of our desire to perpetuate that friendship which was established between the members of the profession of your great nation and ours, in the recent war.

"Established in the year 1784 by Royal Charter, with two main objects in view, viz.: the improvement of medical education and the providing of a sufficient number of properly qualified surgeons for His Majesty's Navy and Army, the Royal College of Surgeons in Ireland has steadfastly endeavored to fulfill those two functions for which it was established, and I think it will be readily admitted that it has done so with commendable success.

"From time to time during the 137½ years of its existence, the President, Vice President, and Council of the College have exercised the right, given them by the Royal Charter, of conferring

the highest honor, viz., The Honorary Fellowship of the College, upon men of great distinction and eminence in the profession, and, on three occasions, upon men of eminence and distinction, not members of the profession, who did honor to the profession and helped to advance the cause of surgical science to some considerable extent.

"In conferring such honors, no doubt the College did honor to itself.

"That the College has by no means been lavish in the distribution of its honors is evidenced by the fact that in the 137½ years of its existence, we find only 69 names on its Honorary Roll.

"These names include such men of eminence and distinction as John Hunter, Percival Pott, Abernathy, Sir Astley Cooper, Sir Benjamin Brodie, Sir John Erichson, Helmholtz, Lord Lister, Pasteur, Sir James Paget, and John Shaw Billings, all of whom have passed away.

"There are but 13 Honorary Fellows now alive, of whom one is not a member of the profession, viz.: His Royal Highness, the Duke of Connaught, K.G., who, when he became Colonel-in-Chief of the Royal Army Medical Corps, was elected an Honorary Fellow. There are, therefore, ony 12 members of the medical profession who now possess the honor. Of these, three were directors of the Army Medical Service who did magnificent work for the profession in their department.

"That leaves 9 members of the surgical profession throughout the world who possess our Honorary Fellowship. Of these, two belong to the great American continent—Harvey Cushing, of Harvard, and Professor Cameron, of Toronto. We are now about to add 8 more distinguished names to our roll, thus making 21 Honorary Fellows, of whom nine will be citizens of the United States.

"In calling upon the distinguished surgeons whom we are to honor to come forward, I may say that I owe a deep debt of gratitude to the ancient Phœnicians and Greeks, who, when questions of precedence arose, which might lead to unpleasantness or diplomatic troubles, settled such questions by the use of the alphabet.

"I propose, therefore, to follow their wise example, and call up those, whom we are to honor, alphabetically: George E. Brewer, New York; George W. Crile, Cleveland; John M. T. Finney, Baltimore; Richard H. Harte, Philadelphia; William Williams Keen, Philadelphia; Charles H. Mayo, Rochester; William J. Mayo, Rochester; and Albert J. Ochsner, Chicago.

"These are all men who have never ceased to be students. They have always been learning while teaching, thus providing by their example that best of all teaching—the teaching how to learn—and showing, by their enthusiasm, the intense pleasure they derive from their search after truth.

"We respect them for their work. We rejoice in their success, and we now honor them for their worth. Men who have served their day and race as these men have all done, require no further eulogy from me to commend them to you.

"I pray you, therefore, Mr. President, confer upon them all the highest honor of the Royal College of Surgeons in Ireland."

The Honorary degrees were conferred by Sir Robert Hy Woods, acting for the President of the Irish College, Sir Edward H. Taylor, B.Ch., B.A.O., who, because of illness, was unable to come to America.

The closing remarks of the ceremony were delivered by Dr. W. W. Keen of Philadelphia, who is universally acknowledged as the dean of surgery. In thanking the Delegation from the Royal College of Surgeons in Ireland, Dr. Keen said:

"Twenty-one years ago, when the Royal College of Surgeons of England conferred the first Honorary Fellowships upon American surgeons, it was my privilege to respond for the Americans. I then said that, though your beloved Queen 'was not monarch of our persons, she was surely queen of our hearts.'

"Since that declaration, a new and deeper tie has bound us more closely than ever, and forever, to you. Two million American troops, even though so late, when you had borne the burden and heat of the conflict for three years, joined you as 'trustees for civilization' (with two million more training at home and pining to join them), and helped to give the *coup de grâce* to the German Army of Desolation. Thousands of our own boys lie beside your own dear ones 'in Flanders' Fields,' and in the sacred soil of France. Never can we forget this tie of blood brotherhood. 'A future breach in our peaceful and friendly relations,' as President Harding well declared but a few days ago, 'is unthinkable.'

"And now in Philadelphia, instead of in Dublin, an unexampled generous exception in your whole history since your charter was granted in 1784, you gentlemen, by order of the Royal College of Surgeons in Ireland, have conferred upon us the highest medical honor which you could bestow.

"As spokesman for my colleagues, I offer to you our sincere and heartfelt thanks, and request that you will convey this message to the College you so well represent."

# THE COLLEGE LIBRARY AND DEPARTMENT OF LITERARY RESEARCH

IN accordance with the action of the Board of Regents last June, the assembling of a large reference library is one of the very vital tasks before the Fellows of the College at the present time. A library built up by the Fellows of the College, for the Fellows of the College and the future members of the surgical profession of America, is bound to become a most complete and valuable collection of surgical literature. It cannot fail to grow rapidly. Such a library, to be representative of the best in American surgery, must contain the works of each and every member of the College. The Board has asked that each Fellow contribute autographed copies of books and reprints of articles written by him. In addition, it has requested him to send in a list of the books and journals, bound and unbound, which he is willing to donate or loan to the College from his private collection. The Board has also laid stress upon the collection of old works of historical interest.

Every effort is being made to obtain the cooperation of the medical publishers, other medical libraries, and the general medical profession throughout the country. Eighty medical journals and year books have already placed the College Library upon their complimentary mailing lists. Soon special funds and endowments will be forthcoming, it is hoped, for the purchase of various groups of books and for the completion of the journal files.

Already the requests have brought a sufficiently hearty response to overflow the available shelf space and to make the College feel the need of the new building, a portion of which may be especially devoted to a research library, with seminar rooms for intensive study, reading rooms, and suitable stack space.

Let the College set as its goal for the coming year the accumulation of a working reference library which will be of immediate service to each Fellow.

The Department of Literary Research will bring such a library within the reach of all the Fellows. Every effort will be made to meet the needs both of the surgeon in the large centers who is too busy to spend hours in a library and has no editorial department in his clinic, and of the pioneer surgeon in the outlying districts. For the latter, there will be special files of clippings, abstracts, and unbound journals, which may be loaned upon request. No pains will be spared in getting to him quickly the data needed on a difficult case or for the preparation of a paper. The Department will do for the Fellows, wherever they may be located, what the editorial or publication department of a large clinic does for the staff of that clinic. It will assist Fellows in the preparation and publication of their scientific books, papers, or lectures. It will prepare special bibliographies, collect material, and make abstracts and translations on any given surgical subject. Later this Department, like the publication department of a clinic, will assist commissions composed of Fellows, in the making of surveys, analyses, and statistical studies, based on various branches of the work of the Fellows. With the establishment of the library in the near future, it is hoped that the Department will be able through an endowment to render a reasonable amount of service to each Fellow of the College without cost to him. The need for such service is obvious. Only the largest clinics have editorial staffs. The high cost of literary assistance given by individuals in libraries or by any of the existing bureaus makes it absolutely prohibitive to the average surgeon.

The Department in the meantime is giving these various types of literary assistance to Fellows at a minimum cost, sufficient only to cover the actual expense of the individual piece of work. That the Fellows are glad to have such work done under the supervision of the College is evidenced by the number and variety of requests which have already been received. During the development of the College Library, the Department has the use of the already existing medical libraries in Chicago. The Department is making every effort to give the greatest service to the greatest number and eventually through an endowment to bring the service within the reach of all.

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